INSTALLATION AND
OPERATION MANUAL

FCD-E1LC

E1/Fractional E1 Managed Access Unit

Version 1.0

RAD
data communications
The Access Company

FCD-E1LC

E1/Fractional E1 Managed Access Unit

Version 1.0

Installation and Operation Manual

Notice

For further information contact RAD at the address below or contact your local distributor.

International Headquarters	North America Headquarters
RAD Data Communications Ltd.	**RAD Data Communications Inc.**
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 Publication No. 289-200-11/08

Limited Warranty

RAD warrants to DISTRIBUTOR that the hardware in the FCD-E1LC to be delivered hereunder shall be free of defects in material and workmanship under normal use and service for a period of twelve (12) months following the date of shipment to DISTRIBUTOR.

If, during the warranty period, any component part of the equipment becomes defective by reason of material or workmanship, and DISTRIBUTOR immediately notifies RAD of such defect, RAD shall have the option to choose the appropriate corrective action: a) supply a replacement part, or b) request return of equipment to its plant for repair, or c) perform necessary repair at the equipment's location. In the event that RAD requests the return of equipment, each party shall pay one-way shipping costs.

RAD shall be released from all obligations under its warranty in the event that the equipment has been subjected to misuse, neglect, accident or improper installation, or if repairs or modifications were made by persons other than RAD's own authorized service personnel, unless such repairs by others were made with the written consent of RAD.

The above warranty is in lieu of all other warranties, expressed or implied. There are no warranties which extend beyond the face hereof, including, but not limited to, warranties of merchantability and fitness for a particular purpose, and in no event shall RAD be liable for consequential damages.

RAD shall not be liable to any person for any special or indirect damages, including, but not limited to, lost profits from any cause whatsoever arising from or in any way connected with the manufacture, sale, handling, repair, maintenance or use of the FCD-E1LC, and in no event shall RAD's liability exceed the purchase price of the FCD-E1LC.

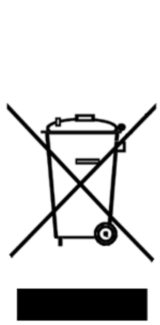
DISTRIBUTOR shall be responsible to its customers for any and all warranties which it makes relating to FCD-E1LC and for ensuring that replacements and other adjustments required in connection with the said warranties are satisfactory.

Software components in the FCD-E1LC are provided "as is" and without warranty of any kind. RAD disclaims all warranties including the implied warranties of merchantability and fitness for a particular purpose. RAD shall not be liable for any loss of use, interruption of business or indirect, special, incidental or consequential damages of any kind. In spite of the above RAD shall do its best to provide error-free software products and shall offer free Software updates during the warranty period under this Agreement.

RAD's cumulative liability to you or any other party for any loss or damages resulting from any claims, demands, or actions arising out of or relating to this Agreement and the FCD-E1LC shall not exceed the sum paid to RAD for the purchase of the FCD-E1LC. In no event shall RAD be liable for any indirect, incidental, consequential, special, or exemplary damages or lost profits, even if RAD has been advised of the possibility of such damages.

This Agreement shall be construed and governed in accordance with the laws of the State of Israel.

Product Disposal



To facilitate the reuse, recycling and other forms of recovery of waste equipment in protecting the environment, the owner of this RAD product is required to refrain from disposing of this product as unsorted municipal waste at the end of its life cycle. Upon termination of the unit's use, customers should provide for its collection for reuse, recycling or other form of environmentally conscientious disposal.

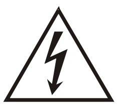
General Safety Instructions

The following instructions serve as a general guide for the safe installation and operation of telecommunications products. Additional instructions, if applicable, are included inside the manual.

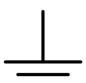
Safety Symbols

Warning

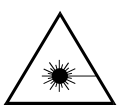
This symbol may appear on the equipment or in the text. It indicates potential safety hazards regarding product operation or maintenance to operator or service personnel.



Danger of electric shock! Avoid any contact with the marked surface while the product is energized or connected to outdoor telecommunication lines.



Protective ground: the marked lug or terminal should be connected to the building protective ground bus.



Warning

Some products may be equipped with a laser diode. In such cases, a label with the laser class and other warnings as applicable will be attached near the optical transmitter. The laser warning symbol may be also attached.

Please observe the following precautions:

- Before turning on the equipment, make sure that the fiber optic cable is intact and is connected to the transmitter.
- Do not attempt to adjust the laser drive current.
- Do not use broken or unterminated fiber-optic cables/connectors or look straight at the laser beam.
- The use of optical devices with the equipment will increase eye hazard.
- Use of controls, adjustments or performing procedures other than those specified herein, may result in hazardous radiation exposure.

ATTENTION: The laser beam may be invisible!

In some cases, the users may insert their own SFP laser transceivers into the product. Users are alerted that RAD cannot be held responsible for any damage that may result if non-compliant transceivers are used. In particular, users are warned to use only agency approved products that comply with the local laser safety regulations for Class 1 laser products.

Always observe standard safety precautions during installation, operation and maintenance of this product. Only qualified and authorized service personnel should carry out adjustment, maintenance or repairs to this product. No installation, adjustment, maintenance or repairs should be performed by either the operator or the user.

Handling Energized Products

General Safety Practices

Do not touch or tamper with the power supply when the power cord is connected. Line voltages may be present inside certain products even when the power switch (if installed) is in the OFF position or a fuse is blown. For DC-powered products, although the voltages levels are usually not hazardous, energy hazards may still exist.

Before working on equipment connected to power lines or telecommunication lines, remove jewelry or any other metallic object that may come into contact with energized parts.

Unless otherwise specified, all products are intended to be grounded during normal use. Grounding is provided by connecting the mains plug to a wall socket with a protective ground terminal. If a ground lug is provided on the product, it should be connected to the protective ground at all times, by a wire with a diameter of 18 AWG or wider. Rack-mounted equipment should be mounted only in grounded racks and cabinets.

Always make the ground connection first and disconnect it last. Do not connect telecommunication cables to ungrounded equipment. Make sure that all other cables are disconnected before disconnecting the ground.

Some products may have panels secured by thumbscrews with a slotted head. These panels may cover hazardous circuits or parts, such as power supplies. These thumbscrews should therefore always be tightened securely with a screwdriver after both initial installation and subsequent access to the panels.

Connecting AC Mains

Make sure that the electrical installation complies with local codes.

Always connect the AC plug to a wall socket with a protective ground.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A. The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A.

Always connect the power cord first to the equipment and then to the wall socket. If a power switch is provided in the equipment, set it to the OFF position. If the power cord cannot be readily disconnected in case of emergency, make sure that a readily accessible circuit breaker or emergency switch is installed in the building installation.

In cases when the power distribution system is IT type, the switch must disconnect both poles simultaneously.

Connecting DC Power

Unless otherwise specified in the manual, the DC input to the equipment is floating in reference to the ground. Any single pole can be externally grounded.

Due to the high current capability of DC power systems, care should be taken when connecting the DC supply to avoid short-circuits and fire hazards.

DC units should be installed in a restricted access area, i.e. an area where access is authorized only to qualified service and maintenance personnel.

Make sure that the DC power supply is electrically isolated from any AC source and that the installation complies with the local codes.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A. The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A.

Before connecting the DC supply wires, ensure that power is removed from the DC circuit. Locate the circuit breaker of the panel board that services the equipment and switch it to the OFF position. When connecting the DC supply wires, first connect the ground wire to the corresponding terminal, then the positive pole and last the negative pole. Switch the circuit breaker back to the ON position.

A readily accessible disconnect device that is suitably rated and approved should be incorporated in the building installation.

If the DC power supply is floating, the switch must disconnect both poles simultaneously.

Connecting Data and Telecommunications Cables

Data and telecommunication interfaces are classified according to their safety status.

The following table lists the status of several standard interfaces. If the status of a given port differs from the standard one, a notice will be given in the manual.

Ports	Safety Status	
V.11, V.28, V.35, V.36, RS-530, X.21, 10 BaseT, 100 BaseT, Unbalanced E1, E2, E3, STM, DS-2, DS-3, S-Interface ISDN, Analog voice E&M	SELV	Safety Extra Low Voltage: Ports which do not present a safety hazard. Usually up to 30 VAC or 60 VDC.
xDSL (without feeding voltage), Balanced E1, T1, Sub E1/T1	TNV-1	Telecommunication Network Voltage-1: Ports whose normal operating voltage is within the limits of SELV, on which overvoltages from telecommunications networks are possible.
FXS (Foreign Exchange Subscriber)	TNV-2	Telecommunication Network Voltage-2: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are not possible. These ports are not permitted to be directly connected to external telephone and data lines.
FXO (Foreign Exchange Office), xDSL (with feeding voltage), U-Interface ISDN	TNV-3	Telecommunication Network Voltage-3: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are possible.

Always connect a given port to a port of the same safety status. If in doubt, seek the assistance of a qualified safety engineer.

Always make sure that the equipment is grounded before connecting telecommunication cables. Do not disconnect the ground connection before disconnecting all telecommunications cables.

Some SELV and non-SELV circuits use the same connectors. Use caution when connecting cables. Extra caution should be exercised during thunderstorms.

When using shielded or coaxial cables, verify that there is a good ground connection at both ends. The grounding and bonding of the ground connections should comply with the local codes.

The telecommunication wiring in the building may be damaged or present a fire hazard in case of contact between exposed external wires and the AC power lines. In order to reduce the risk, there are restrictions on the diameter of wires in the telecom cables, between the equipment and the mating connectors.

Caution To reduce the risk of fire, use only No. 26 AWG or larger telecommunication line cords.

Attention Pour réduire les risques s'incendie, utiliser seulement des conducteurs de télécommunications 26 AWG ou de section supérieure.

Some ports are suitable for connection to intra-building or non-exposed wiring or cabling only. In such cases, a notice will be given in the installation instructions.

Do not attempt to tamper with any carrier-provided equipment or connection hardware.

Electromagnetic Compatibility (EMC)

The equipment is designed and approved to comply with the electromagnetic regulations of major regulatory bodies. The following instructions may enhance the performance of the equipment and will provide better protection against excessive emission and better immunity against disturbances.

A good ground connection is essential. When installing the equipment in a rack, make sure to remove all traces of paint from the mounting points. Use suitable lock-washers and torque. If an external grounding lug is provided, connect it to the ground bus using braided wire as short as possible.

The equipment is designed to comply with EMC requirements when connecting it with unshielded twisted pair (UTP) cables. However, the use of shielded wires is always recommended, especially for high-rate data. In some cases, when unshielded wires are used, ferrite cores should be installed on certain cables. In such cases, special instructions are provided in the manual.

Disconnect all wires which are not in permanent use, such as cables used for one-time configuration.

The compliance of the equipment with the regulations for conducted emission on the data lines is dependent on the cable quality. The emission is tested for UTP with 80 dB longitudinal conversion loss (LCL).

Unless otherwise specified or described in the manual, TNV-1 and TNV-3 ports provide secondary protection against surges on the data lines. Primary protectors should be provided in the building installation.

The equipment is designed to provide adequate protection against electro-static discharge (ESD). However, it is good working practice to use caution when connecting cables terminated with plastic connectors (without a grounded metal hood, such as flat cables) to sensitive data lines. Before connecting such cables, discharge yourself by touching ground or wear an ESD preventive wrist strap.

FCC-15 User Information

This equipment has been tested and found to comply with the limits of the Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the Installation and Operation manual, may cause harmful interference to the radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Canadian Emission Requirements

This Class A digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulation.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Warning per EN 55022 (CISPR-22)

Warning This is a class A product. In a domestic environment, this product may cause radio interference, in which case the user will be required to take adequate measures.

Avertissement Cet appareil est un appareil de Classe A. Dans un environnement résidentiel, cet appareil peut provoquer des brouillages radioélectriques. Dans ces cas, il peut être demandé à l'utilisateur de prendre les mesures appropriées.

Achtung Das vorliegende Gerät fällt unter die Funkstörgrenzwertklasse A. In Wohngebieten können beim Betrieb dieses Gerätes Rundfunkströrungen auftreten, für deren Behebung der Benutzer verantwortlich ist.

Mise au rebut du produit

Afin de faciliter la réutilisation, le recyclage ainsi que d'autres formes de récupération d'équipement mis au rebut dans le cadre de la protection de l'environnement, il est demandé au propriétaire de ce produit RAD de ne pas mettre ce dernier au rebut en tant que déchet municipal non trié, une fois que le produit est arrivé en fin de cycle de vie. Le client devrait proposer des solutions de réutilisation, de recyclage ou toute autre forme de mise au rebut de cette unité dans un esprit de protection de l'environnement, lorsqu'il aura fini de l'utiliser.

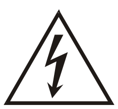
Instructions générales de sécurité

Les instructions suivantes servent de guide général d'installation et d'opération sécurisées des produits de télécommunications. Des instructions supplémentaires sont éventuellement indiquées dans le manuel.

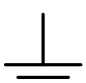
Symboles de sécurité

Avertissement

Ce symbole peut apparaitre sur l'équipement ou dans le texte. Il indique des risques potentiels de sécurité pour l'opérateur ou le personnel de service, quant à l'opération du produit ou à sa maintenance.



Danger de choc électrique ! Evitez tout contact avec la surface marquée tant que le produit est sous tension ou connecté à des lignes externes de télécommunications.



Mise à la terre de protection : la cosse ou la borne marquée devrait être connectée à la prise de terre de protection du bâtiment.

Avertissement

Certains produits peuvent être équipés d'une diode laser. Dans de tels cas, une étiquette indiquant la classe laser ainsi que d'autres avertissements, le cas échéant, sera jointe près du transmetteur optique. Le symbole d'avertissement laser peut aussi être joint.

Veuillez observer les précautions suivantes :

- Avant la mise en marche de l'équipement, assurez-vous que le câble de fibre optique est intact et qu'il est connecté au transmetteur.
- Ne tentez pas d'ajuster le courant de la commande laser.
- N'utilisez pas des câbles ou connecteurs de fibre optique cassés ou sans terminaison et n'observez pas directement un rayon laser.
- L'usage de périphériques optiques avec l'équipement augmentera le risque pour les yeux.
- L'usage de contrôles, ajustages ou procédures autres que celles spécifiées ici pourrait résulter en une dangereuse exposition aux radiations.

ATTENTION : Le rayon laser peut être invisible !

Les utilisateurs pourront, dans certains cas, insérer leurs propres émetteurs-récepteurs Laser SFP dans le produit. Les utilisateurs sont avertis que RAD ne pourra pas être tenue responsable de tout dommage pouvant résulter de l'utilisation d'émetteurs-récepteurs non conformes. Plus particulièrement, les utilisateurs sont avertis de n'utiliser que des produits approuvés par l'agence et conformes à la réglementation locale de sécurité laser pour les produits laser de classe 1.

Respectez toujours les précautions standards de sécurité durant l'installation, l'opération et la maintenance de ce produit. Seul le personnel de service qualifié et autorisé devrait effectuer l'ajustage, la maintenance ou les réparations de ce produit. Aucune opération d'installation, d'ajustage, de maintenance ou de réparation ne devrait être effectuée par l'opérateur ou l'utilisateur.

Manipuler des produits sous tension

Règles générales de sécurité

Ne pas toucher ou altérer l'alimentation en courant lorsque le câble d'alimentation est branché. Des tensions de lignes peuvent être présentes dans certains produits, même lorsque le commutateur (s'il est installé) est en position OFF ou si le fusible est rompu. Pour les produits alimentés par CC, les niveaux de tension ne sont généralement pas dangereux mais des risques de courant peuvent toujours exister.

Avant de travailler sur un équipement connecté aux lignes de tension ou de télécommunications, retirez vos bijoux ou tout autre objet métallique pouvant venir en contact avec les pièces sous tension.

Sauf s'il en est autrement indiqué, tous les produits sont destinés à être mis à la terre durant l'usage normal. La mise à la terre est fournie par la connexion de la fiche principale à une prise murale équipée d'une borne protectrice de mise à la terre. Si une cosse de mise à la terre est fournie avec le produit, elle devrait être connectée à tout moment à une mise à la terre de protection par un conducteur de diamètre 18 AWG ou plus. L'équipement monté en châssis ne devrait être monté que sur des châssis et dans des armoires mises à la terre.

Branchez toujours la mise à la terre en premier et débranchez-la en dernier. Ne branchez pas des câbles de télécommunications à un équipement qui n'est pas mis à la terre. Assurez-vous que tous les autres câbles sont débranchés avant de déconnecter la mise à la terre.

Connexion au courant du secteur

Assurez-vous que l'installation électrique est conforme à la réglementation locale.

Branchez toujours la fiche de secteur à une prise murale équipée d'une borne protectrice de mise à la terre.

La capacité maximale permissible en courant du circuit de distribution de la connexion alimentant le produit est de 16A. Le coupe-circuit dans l'installation du bâtiment devrait avoir une capacité élevée de rupture et devrait fonctionner sur courant de court-circuit dépassant 35A.

Branchez toujours le câble d'alimentation en premier à l'équipement puis à la prise murale. Si un commutateur est fourni avec l'équipement, fixez-le en position OFF. Si le câble d'alimentation ne peut pas être facilement débranché en cas d'urgence, assurez-vous qu'un coupe-circuit ou un disjoncteur d'urgence facilement accessible est installé dans l'installation du bâtiment.

Le disjoncteur devrait déconnecter simultanément les deux pôles si le système de distribution de courant est de type IT.

Connexion d'alimentation CC

Sauf s'il en est autrement spécifié dans le manuel, l'entrée CC de l'équipement est flottante par rapport à la mise à la terre. Tout pôle doit être mis à la terre en externe.

A cause de la capacité de courant des systèmes à alimentation CC, des précautions devraient être prises lors de la connexion de l'alimentation CC pour éviter des courts-circuits et des risques d'incendie.

Les unités CC devraient être installées dans une zone à accès restreint, une zone où l'accès n'est autorisé qu'au personnel qualifié de service et de maintenance.

Assurez-vous que l'alimentation CC est isolée de toute source de courant CA (secteur) et que l'installation est conforme à la réglementation locale.

La capacité maximale permissible en courant du circuit de distribution de la connexion alimentant le produit est de 16A. Le coupe-circuit dans l'installation du bâtiment devrait avoir une capacité élevée de rupture et devrait fonctionner sur courant de court-circuit dépassant 35A.

Avant la connexion des câbles d'alimentation en courant CC, assurez-vous que le circuit CC n'est pas sous tension. Localisez le coupe-circuit dans le tableau desservant l'équipement et fixez-le en position OFF. Lors de la connexion de câbles d'alimentation CC, connectez d'abord le conducteur de mise à la terre à la borne correspondante, puis le pôle positif et en dernier, le pôle négatif. Remettez le coupe-circuit en position ON.

Un disjoncteur facilement accessible, adapté et approuvé devrait être intégré à l'installation du bâtiment.

Le disjoncteur devrait déconnecter simultanément les deux pôles si l'alimentation en courant CC est flottante.

Declaration of Conformity

Manufacturer's Name:	RAD Data Communications Ltd.
Manufacturer's Address:	24 Raoul Wallenberg St., Tel Aviv 69719, Israel

declares that the product:

Product Name:	FCD-E1LC

conforms to the following standard(s) or other normative document(s):

EMC:	EN 55022:1998 + A1:2000, A2:2003	Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement.
	EN 55024:1998 + A1:2001, A2:2003	Information technology equipment – Immunity characteristics – Limits and methods of measurement.
Safety:	EN 60950-1:2001	Information technology equipment – Safety – Part 1: General requirements.

Supplementary Information:

The product herewith complies with the requirements of the EMC Directive 89/336/EEC, the Low Voltage Directive 73/23/EEC and the R&TTE Directive 99/5/EC for wired equipment. The product was tested in a typical configuration.

Tel Aviv, 17 May 2005

Haim Karshen
VP Quality

European Contact: RAD Data Communications GmbH, Otto-Hahn-Str. 28-30, 85521 Ottobrunn-Riemerling, Germany

Quick Start Guide

If you are familiar with the FCD-E1LC, use this guide to prepare it for operation, starting from its factory-default configuration.

1. Preliminary Preparations

At this stage, do not connect any cables to the FCD-E1LC.

Caution Before performing the preliminary preparation procedures described below, review the safety precautions given in *Section 2.1.*

Set all the sections of the rear-panel E1/T1 LOOPBACK switch to OFF.

2. Connection to Power and Grounding

Any interruption of the protective (grounding) conductor (inside or outside the device) or disconnecting the protective earth terminal can make the device dangerous. Intentional interruption is prohibited.

AC power should be supplied to the FCD-E1LC through the 5-foot (1.5m) standard power cable terminated in a standard 3-prong plug.

The connection of the FCD-E1LC to a DC power source is made by means of a cable terminated in the AC/DC adapter (AD) plug.

The AC power cord plug must be inserted in an outlet provided with a protective ground (earth) contact, whereas when using DC power it is necessary to ground the AD grounding terminal. The protective action must not be negated by use of an extension cord (power cable) without a protective conductor (grounding).

Caution FCD-E1LC does not have a power on/off switch, and therefore it will start operating as soon as power is applied. It is recommended to use an external power on/off switch to control the connection of power to the FCD-E1LC. For example, the circuit breaker used to protect the supply line to the FCD-E1LC may also serve as the on/off switch.

3. Cable Connections

Refer to the site installation plan, and connect the prescribed cables to the FCD-E1LC ports:

Cable	Connect to ...
Main link cable	E1/T1 MAIN connector
Sub link cable (optional)	E1/T1 SUB connector
Data channel 1 cable	CH1 connector
Data channel 2 cable (optional)	CH2 connector
Ethernet cable	10/100BASE-T connector

Note *When using adapter cables for the data channels, first connect the adapter cable to the data channel connector, and then connect the user's data cable to the adapter connector.*

When ready, apply power to the FCD-E1LC.

4. Configuration Using a Supervisory Terminal

Starting a Preliminary Configuration Session

1. Connect a terminal to the CONTROL DCE port on the FCD-E1LC rear panel (use a straight cable).

   You may use any standard ASCII terminal (dumb terminal or personal computer emulating an ASCII terminal) equipped with an RS-232 communication interface. *Make sure to use VT-100 terminal emulation.*

2. Configure the terminal for 19.2 kbps, one start bit, eight data bits, no parity, and one stop bit. Select the full-duplex mode, echo off, and disable any type of flow control.

3. Connect the FCD-E1LC to power.

4. Press the <Enter> key several times in sequence: you should see the FCD-E1LC prompt, FCD>.

   If you see PASSWORD> and the FCD-E1LC default password has not yet been changed, type 1234 and then press <Enter> to obtain the prompt. If your password is accepted, you will see the FCD-E1LC prompt.

Note *If you cannot establish communication with the FCD-E1LC, reset FCD-E1LC CONTROL DCE port parameters to the factory defaults using the internal switch SW2 using the procedure described in Chapter 2.*

Configuration Procedure

Perform the following actions in the order given below.

Step	Action	Use the Command
1	Reset the database to the default parameters	**INIT DB**
2	Define the terminal control codes	**DEF TERM**
3	Configure the supervisory port	**DEF SP** **DEF CALL**
4	Set FCD-E1LC system time and date	**TIME** **DATE**
5	Configure management access and system parameters	**DEF SYS** **DEF AGENT** **DEF MANAGER LIST** **DEF ROUTE**
6	Configure the main link parameters	**DEF ML**
7	Configure the sub link parameters (optional)	**DEF SL**
8	Configure the data channel parameters	**DEF CH 1** **DEF CH 2** (when installed)
9	Configure system timing	**DEF SYS**
10	Define the general system parameters	**DEF NAME** **DEF NODE** **DEF PWD**
11	Define the alarm handling parameters	**DEF AR** **DEF ALM MASK**

FCD-E1LC is now ready for operation.

Contents

Chapter 1

Introduction

1.1 Overview

Purpose

The FCD-E1LC is a managed access unit for business applications that integrates voice and data traffic over E1 (2.048 Mbps) and fractional E1 services. FCD-E1LC supports advanced management capabilities, including SNMP.

Product Options

The basic FCD-E1LC is offered with the following payload-carrying ports:

- E1 main link. This port has an ITU-T Rec. G.703 copper interface that can be directly connected to E1/fractional E1 networks. The main link interface type (balanced or unbalanced) is automatically selected in accordance with the cable connected to the port (to support automatic selection, RAD offers a special adapter cable). The interface operating mode, DSU or LTU, is software-selectable. The integral LTU provides a range of up to 2 km.
- User channel 1. The FCD-E1LC is offered with a synchronous high-speed data channel. This data channel can operate at rates of n×64 kbps or n×56 kbps, where n is up to 31. The synchronous data channel can be ordered with RS-530, V.35, V.36, or X.21 interface. The V.35, V.36 and X.21 interfaces are supported by means of adapter cables.

  FCD-E1LC can also accept a 2048 kbps data stream from a data channel and convert it to an ITU-T Rec. G.703 unframed signal for transport over the E1 main link, and thus it can also serve as an interface converter and high-speed, short distance modem.

In addition to the ports available on the basic FCD-E1LC unit, the following additional payload-carrying ports can be ordered:

- E1 sublink. This port has characteristics similar to those of the main link port, and it enables chaining of FCD-E1LC units, drop-&-insert, connection of fractional E1 equipment, connection of a PBX with E1 trunk, etc.
- User channel 2. The FCD-E1LC also supports a second, optional user channel. This channel can be ordered with one of the following interfaces:
  - Synchronous high-speed data channel with characteristics similar to those of channel 1.
  - Asynchronous channel with a V.24 interface.

- 10/100BaseT Ethernet bridge with VLAN support, for direct connection to LANs.

Both optional ports can be added to the same FCD-E1LC unit.

Note *In this manual, the generic term **FCD-E1LC** is used when the information is applicable to all the FCD-E1LC versions. Information applicable to a specific version is explicitly identified.*

Main Features

The FCD-E1LC main and sublink interfaces are compatible with virtually all carrier-provided E1 services, meeting all the applicable requirements of ITU-T Rec. G.823, G.703, G.704, G.706 and G.732. The interfaces support either 2 or 16 frames per multiframe, with or without CRC-4. Line code is HDB3.

Timeslot assignment is programmable, allowing data from each user port to be placed into user-selectable timeslots.

FCD-E1LC supports various timing modes, to meet the specific requirements of user's applications and enable hierarchical dissemination of timing within the network. Its nodal timing can be locked to:

- The clock signal recovered from the main link
- The optional sublink
- The receive clock of a serial data channel.

Alternatively, an internal oscillator can provide the timing.

FCD-E1LC operation can be controlled and monitored by means of supervision terminals, Telnet hosts, and SNMP management stations. The management communication can be either out-of-band, e.g., via connections to the FCD-E1LC serial management port (either directly or through modem links), or inband with the management traffic carried by the main link. These capabilities ensure that FCD-E1LC units can be fully managed from one or more remote locations, in accordance with the specific requirements of the using organization.

FCD-E1LC has a universal power supply that can operate on a wide range of AC and DC power sources, including 100 to 240 VAC, 50/60 Hz and -48/-60 VDC, and has low power consumption.

The FCD-E1LC is available as a standalone unit, intended for installation on desktops or walls. An optional rack mount adapter kit enables installing one or two FCD-E1LC units in a 19-inch rack, occupying only 1U.

1.2 Typical Applications

FCD-E1LC units are used to extend various types of data services over a Fractional E1 network. *Figure 1-1* illustrates the applications supported by FCD-E1LC units.

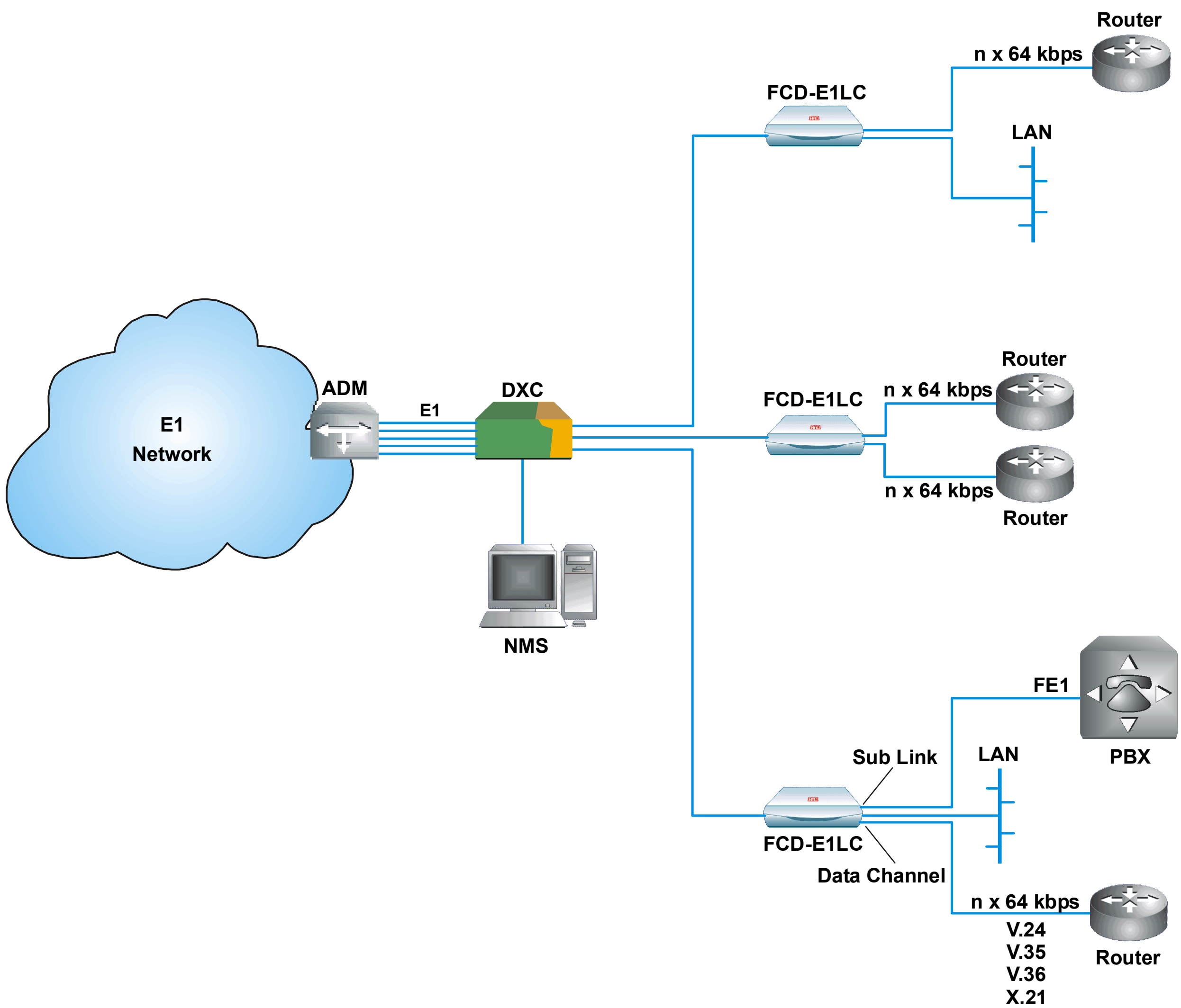


Figure 1-1. FCD-E1LC Applications

The applications supported by the FCD-E1LC include:

- Connection of user's data equipment through the E1 transport network to a router or communication front-end that provides access to additional services.
- When more than one data connection is required, the FCD-E1LC unit can be equipped with a second synchronous data channel that can be independently assigned timeslots on the main link, for connection to other equipment.

- FCD-E1LC units with the optional sublink can be used to interconnect other equipment with fractional E1 interface (for example, a local digital PBX equipped with an E1 trunk can be connected to the PBX at the main office)
- The FCD-E1LC also provides Layer 2 (Ethernet bridge) services between a remote LAN, for example, at a branch office, and the main office LAN. The user can configure the FCD-E1LC to operate either as a LAN extender/repeater that transparently transfers all the traffic on the local LAN to the remote LAN, or as a remote bridge that filters the LAN traffic and blocks traffic addressed to local stations. The FCD-E1LC bridge supports VLANs and quality-of-service features.

The user can select the main link bandwidth allocated to each type of traffic in accordance with the desired throughput.

1.3 Physical Description

Figure 1-2 shows a general view of a typical FCD-E1LC unit. FCD-E1LC is a compact standalone unit, intended for installation on desktops or shelves. Unit height is only 1U (1.75"). An optional rack-mount adapter kit enables the installation of one or two FCD-E1LC units (side by side) in a 19-inch rack.

FCD-E1LC is cooled by free air convection, and does not include internal fans. The FCD-E1LC front panel includes only indicators that indicate its status.

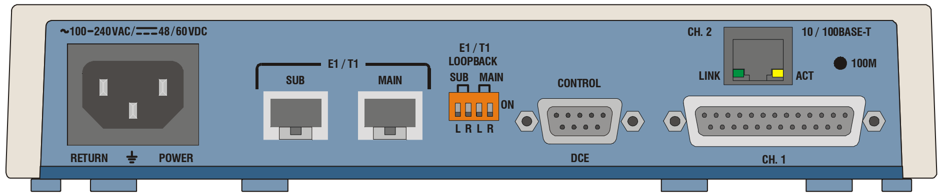
Figure 1-2. FCD-E1LC, General View

All the connections are made to connectors located on the rear panel. Two typical rear panels are shown in *Figure 1-3* (your panel may look different, depending on the ordered options). The rear panel includes the following connectors:

- POWER connector – for connection to the power source (AC or DC)
- MAIN connector – for the FCD-E1LC main link connection
- SUB connector (optional) – for connection to the FCD-E1LC sublink
- CONTROL DCE connector – for connection to the serial supervisory port
- CH.1 connector – for connection to the channel 1 serial data port
- CH.2 connector (optional) – for connection to the channel 2 serial data port

or

CH.2 LAN connector (optional) – for connection to the 10/100Base-T Ethernet port.



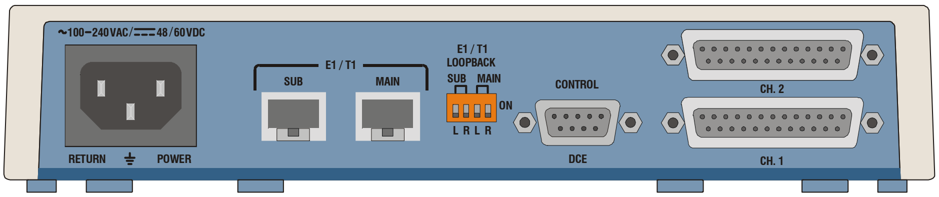


Figure 1-3. Typical FCD-E1LC Rear Panels

1.4 Functional Description

Functional Block Diagram

Figure 1-4 shows the functional block diagram of the FCD-E1LC system.

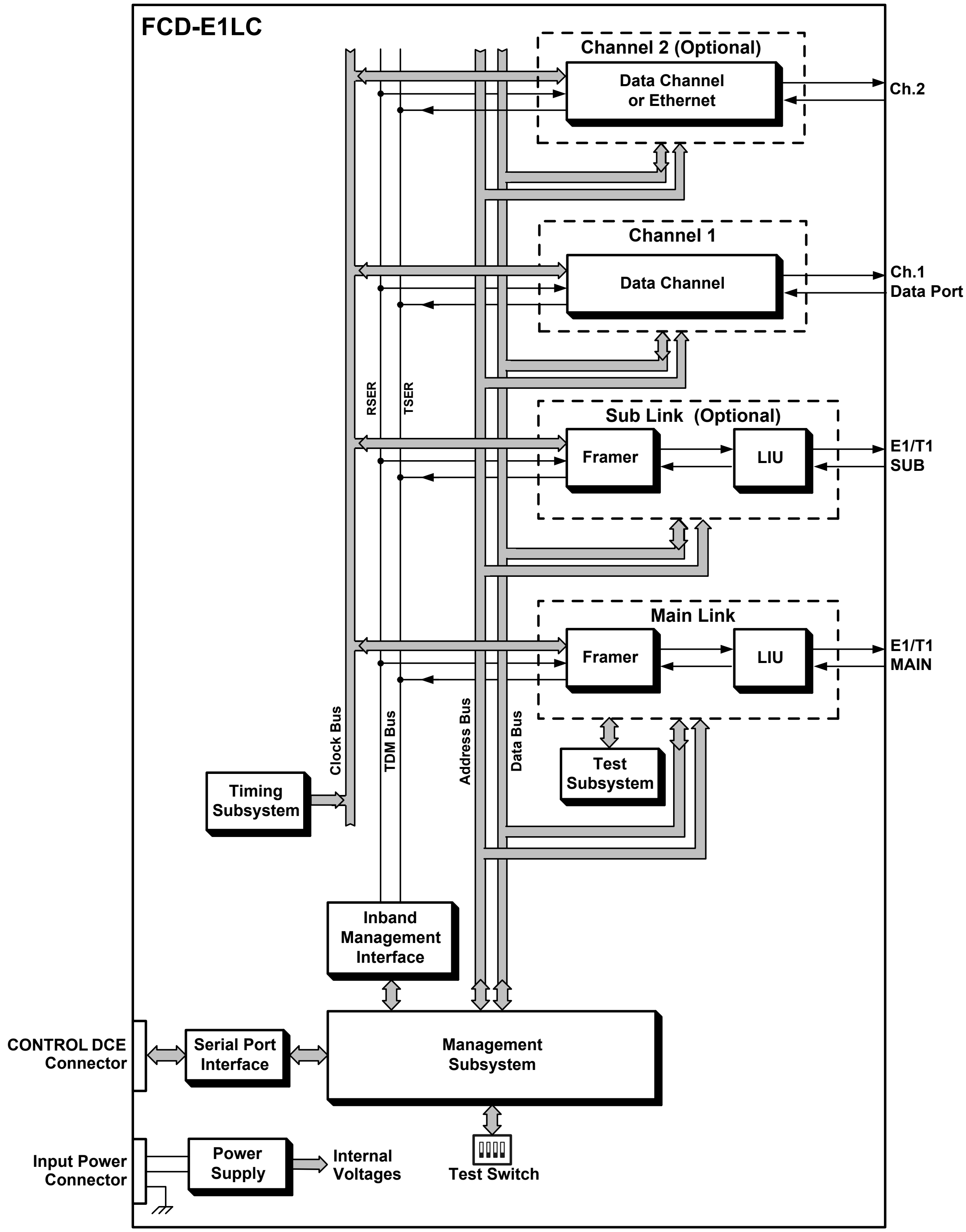


Figure 1-4. FCD-E1LC Functional Block Diagram

FCD-E1LC includes several main subsystems:

- Internal buses
- Main link interface
- Sublink interface

- User interface subsystem (data channels with serial interfaces and Ethernet port)
- Timing subsystem
- Test subsystem
- Management subsystem
- Power supply subsystem.

The characteristics of the various subsystems are explained below.

Internal Bus Functions

The FCD-E1LC system performs its various functions by controlling the flow of data among the various user, sub and main link interfaces in accordance with the application requirements.

The flow of data is performed through the FCD-E1LC buses, as shown in *Figure 1-4*. FCD-E1LC comprises several buses:

- TDM bus, which carries the data to the main link. The TDM bus serves as a highway through which all the information processed by the FCD-E1LC flows. The information is deposited and collected in discrete time intervals, called timeslots (one timeslot supports a data rate of 64 kbps – see *Appendix C*). The TDM bus consists of two lines:
  - TSER line – carries the transmit data to the main link interface. The other interfaces deposit data on this line, in the timeslots specified by the management subsystem.
  - RSER line – carries the data received by the main link interface. The other interfaces read their data from the timeslots specified by the management subsystem.

  Each FCD-E1LC port deposits payload information received through its external interface on one TDM bus line, and simultaneously collects the information to be sent through the external interface from the other line. Therefore, considerable flexibility is available with respect to routing, because each port has access to all the payload information, and can be instructed by the management subsystem to read and write the desired information in the desired timeslots of the FCD-E1LC TDM bus.
- Clock bus, which carries the various clock signals used by the FCD-E1LC system. The FCD-E1LC can lock its system (nodal) clock to various clock signals applied to its ports, in accordance with the application requirements.
- Two management buses:
  - Address bus – carries routing information from the management subsystem to the other subsystems.
  - Data bus – carries the internal management data.

Main Link Interface

The main link interface includes a framer and an LIU (line interface unit). The characteristics and the main functions of the main link interface are described below.

Main Link Interface Characteristics

The FCD-E1LC main link meets the applicable requirements of ITU-T Rec. G.703, G.704, G.706, G.732, G.823 and G.826.

The main link port is terminated in an RJ-45 eight-pin connector that supports two interfaces: 120Ω balanced line interface and 75Ω unbalanced interface. Normally, the main link uses the balanced interface; to use the unbalanced interface, all that is needed is to connect the appropriate RJ-45-to-BNC adapter cable, CBL-RJ45/2BNC/E1/X (offered by RAD). In this case, the interface is automatically changed and the user’s equipment can be connected to standard BNC female connectors at the free end of the adapter cable.

The line code is HDB3. The operating mode of the main link interface, DSU or LTU, is user-selectable. In the DSU mode, the maximum line attenuation is up to 10 dB; in the LTU mode, the maximum line attenuation is up to 36 dB, which for typical cables translates to a range of up to 2 km. This allows the FCD-E1LC to be placed at a distance of up to 2 km.

The interface supports both G732N framing (2 per multiframe) and G732S framing (16 frames per multiframe, also called timeslot 16 multiframes), in accordance with ITU-T Rec. G.704 and G.732. The user can also configure the main link to use the CRC-4 function in accordance with ITU-T Rec. G.704. The use of the CRC-4 function, as well as the framing mode, is user-selectable.

FCD-E1LC main link can also be operated in an unframed mode, to generate an ITU-T Rec. G.703 unframed signal. In this mode, FCD-E1LC accepts a 2048 kbps data stream through a synchronous data channel (or from the optional sublink) and converts it to an ITU-T Rec. G.703 unframed signal for transport over the E1 main link.

Framer

The transmit path of the framer generates the E1 frame structure transmitted by the main link port, in accordance with the selected framing mode. The frame structure is generated by combining the data retrieved from the prescribed timeslots of the TSER line with the framing overhead, when the main link-framing mode is G732S or G732N. The TSER line may also carry inband management data generated by the management subsystem Unused timeslots are filled with a user-selected idle code.

The receive path of the framer extracts the payload data, the inband management data stream and demultiplexes the incoming E1 data stream.

The framer also collects performance statistics based on framing errors, bipolar coding violations and errors detected by the CRC-4 monitoring function. These statistics can be read by the FCD-E1LC management subsystem.

Note *When the main link is operated in the unframed mode, the framer is bypassed. In this mode, the main link transparently transfers the data stream received from one of the data channels. The appropriate data channel is automatically selected: channel 1 for an FCD-E1LC with one data channel, and channel 2 for an FCD-E1LC with two data channels.*

Note that when the optional sublink operates in the unframed mode, it is also automatically bypassed to the main link, but in this case all the other FCD-E1LC ports are disabled.

Handling of National Bits

FCD-E1LC enables you to control the handling of the national bits, S_{a4} through S_{a8}, in timeslot 0. You can select the utilization and state of each bit, in accordance with the following options:

- Transfer of management traffic: when the inband management traffic is carried in timeslot 0, the user can select the S_a bits that will carry the traffic.
- Setting any S_a bit to the desired fixed value, "0" or "1".

LIU

The transmit path of the LIU includes an HDB3 coder, which converts the NRZ transmit data stream provided by the E1 framer to the line code specified for use on E1 links, and then generates the E1 transmit signal in accordance with ITU-T Rec. G.703.

The receive path of the LIU recovers the received E1 signal and the associated clock signal. The recovered clock signal is used by other FCD-E1LC circuits, and is also applied on the clock bus. The recovered E1 signal is decoded by an HDB3 decoder, and sent to the receive path of the E1 framer in NRZ format.

The operating mode of the LIU receive path, DSU or LTU, is user-selectable.

The HDB3 decoder can provide performance statistics for evaluating line transmission quality even when the CRC-4 option is not used, by collecting data on the bipolar violations (BPVs) detected in the incoming signal.

Sublink Interface

The optional sublink interface has characteristics similar to that of the main link interface. The only difference is in wiring: the transmit and receive pairs in the sublink RJ-45 connector are reversed relative to the main link, thereby enabling connection of equipment with standard balanced interface by means of a straight (point-to-point) cable. Therefore, a different adapter cable, CBL-RJ45/2BNC/E1 (also offered by RAD), is needed to use the unbalanced interface.

Synchronous Data Channels

Data Channel Interface Characteristics

The FCD-E1LC data channel is available with one of the following types of interfaces: RS-530, V.35, X.21, or V.36/RS-449. All versions are supplied with a 25-pin D-type female connector.

V.24 interface equipment connects to the RS-232 port of the FCD-E1LC using a standard straight cable.

All other interface versions are terminated in a 25-pin D-type female connector. The conversion between the 25-pin channel interface connector and the standard V.36, V.35, or X.21 interface connectors is made by means of adapter cables:

- V.36 interface: the adapter cable is terminated in a 37-pin D-type female connector.
- V.35 interface: the adapter cable is terminated in a 34-pin female connector.
- X.21 interface: the adapter cable is terminated in a 15-pin D-type female connector.

Suitable adapter cables can be ordered from RAD.

The data channel interface supports the following control lines:

- RTS – input from the local user's equipment.
- CTS – output to the local user's equipment. This line can be configured to be always in the active state, or track the state of the RTS line.
- DSR – the DSR line is always active when the FCD-E1LC is powered, except when a remote loopback is activated on the main link.
- DCD – the DCD line is active when the FCD-E1LC main link interface is synchronized.

Data Channel Processing

The data channel operates as a synchronous port, which connects to the TDM bus via a bus interface. The data channel performs two main functions:

- In the output (receive) direction, the bus interface reads the payload data from the appropriate timeslots of the TSER line, under the control of the management subsystem, and generates a continuous $n \times 64$ kbps or $n \times 56$ kbps data stream. The data stream is accompanied by a clock signal derived from the internal FCD-E1LC system clock.

  The transmit data and clock signals are then applied to the channel interface, which provides the interface to the external (user's) equipment.
- In the input (transmit) direction, the user's data applied to the input of the channel interface is placed in the appropriate timeslots of the RSER line, under the control of the management subsystem.

To enable synchronous operation, FIFO buffers are used to absorb timing variations (jitter, wander, etc.). In all the data channel timing modes, the FIFO

size is automatically selected in accordance with the data channel rate, as listed in *Table 1-1*.

The values listed in *Table 1-1* are selected in accordance with the limits specified in the applicable standards.

In addition, when using the DTE2 mode, the FIFO size can also be manually selected, to enable the user to increase FIFO size when the jitter exceeds the expected limits.

Table 1-1. FIFO Size vs. Data Channel Rate

Data Channel Rate (kbps)	**FIFO Size** (bits)
64	±16
128 and 192	±30
256 through 512	±52
576 through 1024	±72
1088 through 1792	±52
1856 and 1920	±30
1984	±16

In addition to payload data, the data channel interfaces handle two additional types of signals:

- Clock signals. The direction of the clock signals depends on the data channel timing mode, DCE, DTE1, or DTE2. The timing modes are explained in the *Synchronous Data Channel Timing* section on page *1-14*.

  In the DTE2 mode, the clock signal applied to the transmit input is connected to the clock bus and can be selected as an FCD-E1LC system timing reference.

- Handshaking signals. The handshaking signals are used to control the exchange of signals with the user's equipment, in accordance with the protocol applying to the installed data channel interface. The handshaking is performed under the control of the management subsystem.

  The functions of the handshaking signals are explained on page *1-10*.

Asynchronous Data Channel RS-232/V.24

This interface allows FCD-E1LC to operate opposite external user equipment at bit rates 1.2, 2.4, 4.8, 9.6, 19.2, or 38.4 kbps. The data rate of the V.24 port can be selected between 64 kbps and 128 kbps.

Ethernet Interface

The FCD-E1LC can be ordered with a full-feature Ethernet switch with VLAN support that provides remote bridge services.

The Ethernet switch has a 10/100BaseT interface terminated in a shielded RJ-45 connector for direct connection to LANs.

Ethernet Port Interface Characteristics

The Ethernet port 10/100Base-T LAN interface supports auto-negotiation. However, the user can also disable auto-negotiation and specify directly the operating rate (10 or 100 Mbps) and operating mode (half-duplex or full-duplex).

The auto-negotiation process uses a standard protocol that permits intelligent 10/100BaseT Ethernet ports to automatically select the mode providing the highest possible traffic handling capability. Therefore, when auto-negotiation is enabled, the Ethernet port automatically selects the appropriate operating mode as soon as it is connected to a LAN or to another Ethernet port.

The following additional capabilities are also available:

- Automatic detection and correction of MDI/MDIX crossover and polarity, which enables connecting the FCD-E1LC Ethernet port to any other port (station or hub) by any type of cable (straight or cross-wired)
- Use of 802.3 flow control in the full-duplex mode and backpressure flow control in the half-duplex mode.

The timing mode of the Ethernet channel interface is always DCE (that is, within the FCD-E1LC the timing of the receive and transmit Ethernet channel paths is always locked to the FCD-E1LC system clock).

Ethernet Switch Description

The FCD-E1LC includes an Ethernet switch with VLAN support that fully complies with the IEEE 802.3/Ethernet V.2 standards, has user-selectable forwarding algorithms, and provides extensive support for QoS features.

The Ethernet switch has two ports:

- An external port connected to the Ethernet (LAN) interface of the FCD-E1LC, supported by a MAC controller that performs all the functions required by the IEEE 802.3 protocol.
- An internal port connected to the main link interface of the FCD-E1LC, which can be assigned timeslots in accordance with the desired throughput. This port supports the HDLC protocol.

The frames passed by the MAC controller are transferred to an internal queue controller, which controls the frame egress priorities and inserts them in two separate queues.

Flow Control Options

The user can enable flow control. Flow control is available in both the half-duplex and full-duplex modes:

- In the half-duplex mode, flow control uses a collision-based scheme to throttle the connected stations when the free buffer space of the FCD-E1LC Ethernet port is too low, to avoid discarding frames during congestion (this approach is called *back pressure*). When the buffer space of the port is almost full, its MAC controller forces a collision in the input port when an incoming frame is sensed (the alternative, without flow control, is to discard the incoming frame).

- In the full-duplex mode, the standard flow control method defined in IEEE 802.3x is used. This method is based on *pause* frames and enables stopping and restoring the transmission from the remote node. However, this method can only be used when auto-negotiation is enabled on the port, and the node attached to the port supports *pause* frames.

Forwarding Algorithms

The Ethernet switch operates as a MAC bridge that automatically learns the MAC addresses located on the local LAN.

The Ethernet switch LAN table can store up to 2048 MAC addresses. Only active MAC addresses are actually stored: after a user-defined aging interval, inactive addresses are removed from the switch memory.

VLAN and QoS Support

The Ethernet switch can use the priority information carried in the VLAN tag or the type of service (ToS) precedence for frames carrying IP packets to select the priority with which traffic will be forwarded:

- If the frame is tagged, the switch uses the priority value carried by the VLAN tag to determine the output queue to which the frame is transferred
- If the frame is not tagged but carries an IP packet, the switch uses the precedence value carried in the ToS field to determine the output queue to which the frame is transferred
- Other untagged frames are transferred to the low-priority queue.

Table 1-2 lists the queuing priorities.

Table 1-2. Output Queuing Priorities

Priority in VLAN Tag (Tagged Frames)	Precedence in ToS Filed (Untagged Frames)	Output Queue
7, 6, 5, 4	7, 6, 5, 4	High priority
3, 2, 1, 0	3, 2, 1, 0	Low priority

The switch uses the weighted fair queue scheduling mode: 2:1 weighting is applied to the two priorities, that is, when the output queues are full, 2 frames are egressed from the high priority queue for each frame in the low priority queue. This approach prevents the lower priority frames from being starved out with only a slightly increased delay to the higher priority frames.

Timing

Multiple clock source selection provides maximum system timing flexibility, and supports hierarchical dissemination of timing information.

System Timing

Internally, the FCD-E1LC uses one timing source (clock). This system clock determines the transmit timing of the E1 main and sublinks and user channels, and the timing of most other signal processing operations.

To achieve maximum flexibility in system integration and enable hierarchical distribution of timing in the system, the FCD-E1LC enables you to select the source to which the master clock is locked. The available options are as follows:

- Reference source locked to the recovered receive clock of the main link.
- Reference source locked to the recovered receive clock of the sublink.
- Reference source locked to an external clock (such as the transmit clock applied to a data channel using the DTE2 mode).

Note *The DTE2 mode is not available when the data channel uses the X.21 interface.*

The Ethernet interface cannot be used as a reference source.

- System clock source locked to the internal crystal oscillator, which has an accuracy of ±50 ppm.

In addition to the selection of a master clock source, you can specify a fallback source, which is automatically selected in case the master source fails. The fail criteria are loss of the receive signal on the port selected as the master source, or inactive RTS line on the data channels. The internal oscillator always serves as a fallback source, which is automatically selected in case the other selected timing sources fail.

Main Link Timing

FCD-E1LC recovers the main link receive clock signal, and uses it as the timing source for the receive path. The main link transmit timing source, which is derived from the main system clock, can be locked to one of the following sources:

- Recovered receive clock
- External clock signal derived from one of the synchronous data channels)
- Sublink recovered receive clock
- Internal oscillator.

Sublink Timing

FCD-E1LC recovers the sublink receive clock signal, and uses it as the timing source for the receive path. The sublink transmit timing source is always derived from the main system clock.

Synchronous Data Channel Timing

The FCD-E1LC data channel has three timing modes:

- DCE – transmit and receive clock for the user's equipment connected to the data channel are derived from the main system clock.

- DTE1 – the data channel sends the receive data accompanied by the receive clock, derived from the main system clock, to the user's equipment connected to the data channel, and accepts user's data according to the user's equipment transmit clock.
- DTE2 – FCD-E1LC transmits and receives data according to the clock signals provided by the equipment connected to the data channel. When using this clocking mode, the main link clock is locked to the clock signal supplied by the user's data channel interface. The DTE2 mode is not available on channels with X.21 interfaces.

FCD-E1LC provides a FIFO buffer for the data channel, to absorb timing differences. FIFO size is generally automatically selected, however, in the DTE2 timing mode the user can increase the FIFO size beyond the automatically selected value, to meet specific system requirements.

V.24 Data Channel Timing

The V.24 data channel operates only in the DCE timing mode.

Ethernet Port Timing

The timing of the Ethernet processing circuits is always derived from the main system clock ("DCE" timing). This port cannot be selected as a timing source.

Diagnostics

FCD-E1LC has comprehensive diagnostics capabilities that include the following types of loopbacks and tests:

- Main link:
  - Local analog loopback
  - Remote analog loopback
  - Local digital loopback
  - Remote digital loopback
  - Inband-activated loopback in the desired timeslots (both transmission to a remote unit, and activation/deactivation in response to an inband loopback code)
  - BER testing in the desired timeslots. To provide compatibility with other BER testing equipment, the user can select the pattern used for the test from a wide range of patterns, including standard pseudorandom patterns.
- Sublink:
  - Local analog loopback
  - Remote analog loopback
  - Local digital loopback
  - Remote digital loopback

- Serial data channels: local and remote loopbacks.

Timeslot Handling

When operating in any of the framed modes, FCD-E1LC allows you to configure the routing of the individual timeslots for the data channels (including the Ethernet interface) and for the sublink. The routing can be modified during system operation, without disrupting the service to users of timeslots that are not rerouted. FCD-E1LC automatically connects the timeslots in both the receive and transmit directions.

You can either individually select the main link timeslots in which the user's data is to be inserted, or can use the "bundle" routing mode. Timeslots connected to data channels are always defined as data timeslots.

To help you route timeslots correctly, FCD-E1LC automatically checks the validity of your inputs, and reports, by means of error messages, inconsistencies and invalid selections. The conditions reported include:

- Attempt to allocate to user's traffic timeslots that must be reserved for system use: timeslot 16 when G732S multiframes are used, or a timeslot dedicated to the management traffic between two FCD-E1LC units connected in a link.
- Total bandwidth requested exceeds the available main link bandwidth:
  - Maximum possible – 31 timeslots.
  - Maximum 30 timeslots when using G732S framing, or G732N framing with a timeslot dedicated to management.
  - Maximum 29 timeslots when using G732S framing and a timeslot dedicated to management.

  When a sublink is installed, the available main link bandwidth is reduced by the number of timeslots configured as the sublink payload.
- Number of timeslots assigned to the data channel(s) does not match the number required to support the selected data rate.

Management Subsystem

The management subsystem controls FCD-E1LC operation, in accordance with its operating software. The management subsystem also includes an SNMP agent, and a proprietary IP router for SNMP management traffic.

The database management, as well as the other configuration, test and monitoring activities (equipment status reading, alarm status and history, activation of test loops, reading of performance statistics, etc.) can be performed in three ways:

- Supervision Terminal – A "dumb" ASCII terminal connected to the RS-232 port of the FCD-E1LC (or a PC running a terminal emulation program), controlled by the program stored in the FCD-E1LC, can be used as a supervision terminal. FCD-E1LC supports both point-to-point and multidrop connections.

- **SNMP Management** – The SNMP management capability enables fully graphical, user-friendly management using the RADview network management stations offered by RAD, as well as management by other SNMP-based management systems.
- **Telnet** – Remote management is also possible using the Telnet communication protocol, which uses TCP/IP communication, without the SNMP service. Telnet support enables a remote IP host to control the operation of FCD-E1LC using functions identical to those provided by a supervision terminal.

The communication between the management system and FCD-E1LC can take place out-of-band (by connecting to the serial management port) or inband (through the main link). FCD-E1LC includes a proprietary IP router for management traffic. This function enables FCD-E1LC to transfer management traffic generated by, or addressed to, other FCD-E1LC units, and also inband management traffic addressed to other RAD equipment that operates over E1 links, such as the Megaplex modular TDM E1/T1 multiplexers, DXC multiservice access nodes, etc.

Dial-In and Dial-Out Capabilities

FCD-E1LC supports dial-in/dial-out operations, which can be used for remote out-of-band configuration and monitoring (dial-in). For dial-out operation FCD-E1LC activates the modem to automatically dial a pre-programmed number whenever an alarm event occurs.

The remote out-of-band configuration, monitoring and sending callout alarm messages can be done using the ASCII (terminal), PPP or SLIP protocols.

Alarms

FCD-E1LC stores alarms detected during its operation in a buffer that can hold up to 100 alarms. During regular operation, an alarm indicator on the front panel is used to notify the local operator that alarm conditions have been detected. Separate indications are provided for major and minor alarms. The local operator can then review the contents of the alarm buffer using the supervision terminal, a Telnet host, or a management station.

The front-panel LED indicators display in real time the status of the main and sublinks, and alert when test loops are present in the system. FCD-E1LC can also automatically report alarms to a remote terminal using a dial-up modem. Alarms causing dial-out activities are user-selectable.

The alarms stored in the FCD-E1LC alarm buffer can be transmitted automatically through the serial management access port, for display on a supervision terminal; when SNMP management is used, alarms are also sent to user-selected management stations as traps.

The CONTROL DCE port can be configured to operate as a dial-out port, for automatic reporting of alarms to remote locations. The port is intended for connection to a Hayes™ or Hayes-compatible dial-up modem. You can program the reporting method in accordance with the following options:

- Always send a report whenever a new alarm condition is detected.

- Send a report only upon the detection of a major alarm.
- Reporting disabled (no dial-out function).

When it is necessary to report an alarm condition, FCD-E1LC initiates the call setup, and then, after the destination answers, sends the complete contents of the alarm buffer. Following the transmission of the alarm buffer contents, FCD-E1LC disconnects automatically.

To increase reporting reliability, you can define the number of dialing retries, and an alternate directory number to be called in case the primary directory number cannot be reached. If nevertheless the call cannot be established, the full contents of the buffer will be sent the next time a call is set up.

To expedite the handling of alarms and reduce the information load during system malfunctions, the system operator can mask alarm conditions, to prevent continuous reporting of known alarm conditions, e.g., during maintenance activities.

Statistics Collection

FCD-E1LC collects and stores E1 port statistics in compliance with ITU-T Rec. G.706, G.826, with local support as per RFC 1406.

These statistics can be retrieved either from the management station (RADview), or via the supervision terminal.

The management subsystem exchanges information and sends commands through several ports:

- The communication with the various internal subsystems of the FCD-E1LC is performed through the management address and data buses. The subsystem also controls the front-panel indicators.
- The communication with the supervision terminal is performed through the front panel RS-232 serial port interface. This port is used to perform the initial configuration of the FCD-E1LC, using any standard ASCII (“dumb”) terminal (or PC running a basic communication or terminal emulation program). After the initial configuration, the port can be used to control and monitor FCD-E1LC operation.
- When inband management is enabled, the management subsystem transmits and receives management traffic through the E1 main and/or sub port. The communication with the E1 port is made through the TDM bus.

Power Supply Subsystem

FCD-E1LC has a universal wide-range power supply, which enables operating on 100 to 240 VAC, 50/60 Hz, or -48/-60 VDC.

1.5 Timing Considerations

Main Link Timing Application

Figure 1-5 shows a typical application in which FCD-E1LC is operated with the main link as the timing reference source, and illustrates the flow of timing signals within the system.

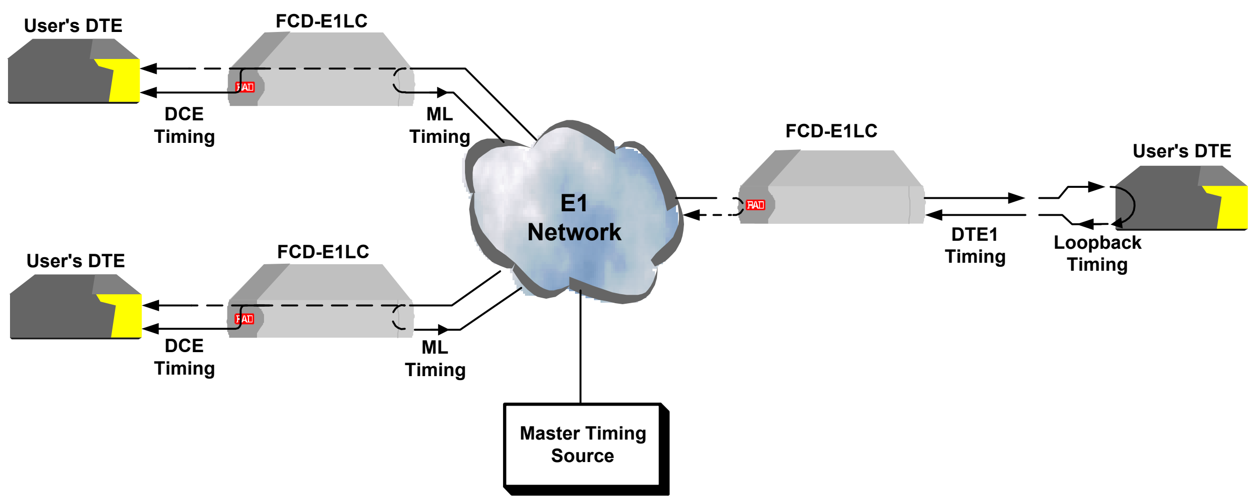


Figure 1-5. Main Link Timing, Flow of Timing Signals in a Typical Application

When using the main link as the timing reference, the data channels must use DCE timing. However, DTE1 timing can also be used, provided the user's equipment connected to the data channels operates with loopback timing, that is, the user's equipment must lock its transmit clock to the receive clock provided by FCD-E1LC.

FIFO buffers are used on the data channels, to absorb small timing variations (jitter, wander, etc.). FIFO size is automatically selected in accordance with the data channel rate, as listed in *Table 1-1*.

The main link timing mode is particularly suitable for FCD-E1LC units connected to an E1 network which has an accurate master timing source (e.g., PTT or national network), because it enables locking the timing of the equipment connected to the FCD-E1LC units to the network timing.

Data Channel Timing Application

Figure 1-6 shows a typical application, which uses the data channel operating in the DTE2 timing mode, as the timing reference source, and illustrates the flow of timing signals within the system.

In the application shown in *Figure 1-6,* the data equipment located on the customer's premises uses the FCD-E1LC link to connect to a data network. Since data networks include accurate timing sources and do not accept data whose timing deviates significantly from the network timing, it is necessary to ensure that the equipment located on the customer's premises uses the data network timing.

For this purpose, the FCD-E1LC connected to the data network uses the data channel as its timing source, and therefore its main link timing is locked to the data network timing.

The FCD-E1LC located on the customer's premises uses main link timing. As a result, its system timing is also locked to the data network timing, and the network timing is transferred to the data equipment located on the customer's premises.

To optimize jitter performance, the FIFO size of a data channel operating in the DTE2 mode can be selected manually (±16 bits, ±30 bits, ±52 bits, or ±72 bits). The manually selected value cannot be less that the automatically selected values, which are listed in *Table 1-1*.

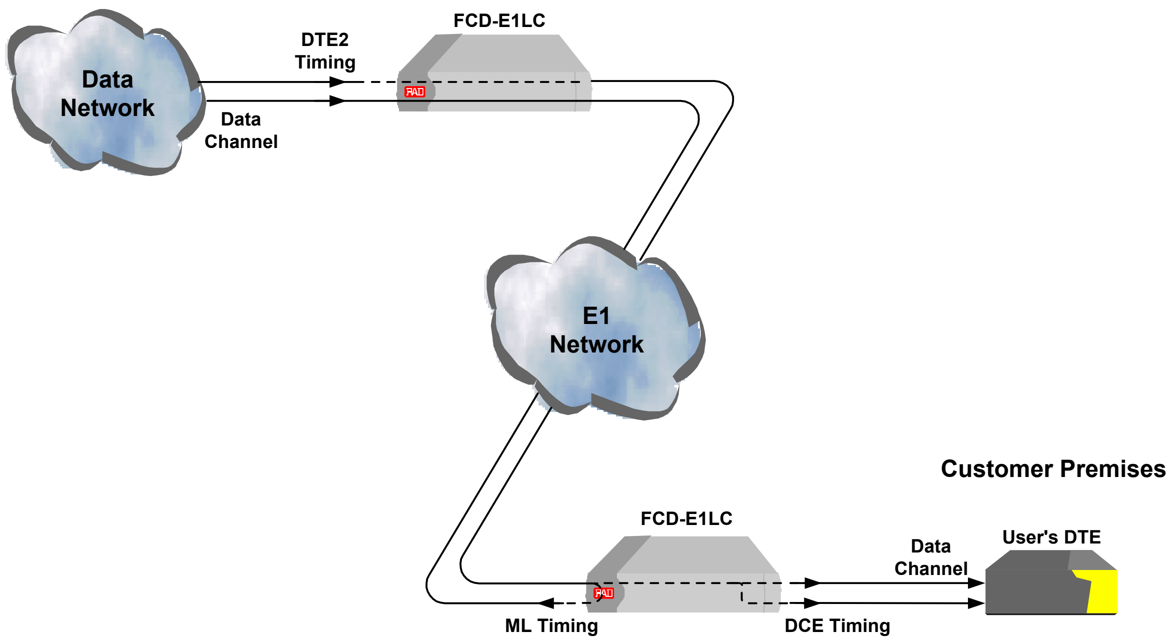


Figure 1-6. Data Channel Timing, Flow of Timing Signals in a Typical Application

1.6 System Management Considerations

System Management Method

The FCD-E1LC system is designed for unattended operation. The configuration of the FCD-E1LC system, that is, a complete collection of operating parameters, is determined by a database stored in non-volatile memory located in the management subsystem. The database is automatically loaded upon FCD-E1LC turn-on, thereby enabling the FCD-E1LC to automatically return to its last operating configuration.

In addition, FCD-E1LC stores a set of factory-default parameters, which can be used to start the configuration of a new FCD-E1LC unit; the default parameters can also be loaded in case the user's database is corrupted.

FCD-E1LC database management, as well as the other configuration, test and monitoring activities (equipment status reading, alarm status and history,

activation of test loops, reading of performance statistics, etc.) can be performed in three ways:

- Supervision Terminal
- SNMP Management
- Telnet.

Management Access Options

The control subsystem of FCD-E1LC systems supports both out-of-band and inband management access.

- For out-of-band management, the connection is made through the front panel serial port, via the SLIP or PPP protocol. The routing is performed with a RAD proprietary routing protocol.
- Inband management is performed via the main E1 link, and/or the sublink (optional). See *Appendix B* for details.

Supervision Terminal Capabilities

The supervision terminal provides a simple, command-line based human interface. The terminals can communicate with the managed FCD-E1LC systems via the CONTROL DCE serial RS-232 communication port.

The serial port is generally configured as a DCE port, for direct connection to a terminal, but can also be configured as a DTE port when it is necessary to connect the terminal via a modem link, or a low-speed data multiplexer channel. Thus, a remote operator located at a central site can perform all the functions available from a supervision terminal directly connected to the FCD-E1LC system. Optional password protection is also available.

The communication data rate of the serial port can be selected in accordance with system requirements (1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200 bps). Automatic data rate identification (Autobaud function) is also available. Data word format is configurable: one start bit, eight data bits, selectable parity (odd, even, or none), and one or two stop bit.

Since continuous communication with the FCD-E1LC system is necessary only when management activities are actually performed, one terminal can manage multiple FCD-E1LC units using a polling protocol, with the connection to the individual units being made by means of multi-drop modems or digital sharing devices. For polling purposes, each FCD-E1LC can be assigned an eight-bit address, for a maximum of 255 nodes (the zero address is reserved for non-polled communication).

SNMP Management Capabilities

The FCD-E1LC system includes an SNMP agent that can communicate out-of-band and/or inband through the dedicated management router of the FCD-E1LC system. To permit SNMP management, you must configure and enable the SNMP agent. *Appendix B* provides information on the required parameters.

A basic management topology is shown in *Figure 1-7*. In this example, a network management station is attached to an Ethernet LAN. A remote access LAN extender, MBE-RAS/A, is located near the managed equipment (e.g., FCD-E1LC,

Megaplex-2100, etc.), and its serial ports are connected via cables to the serial port of the FCD-E1LC CONTROL DCE connector using the SLIP protocol.

The MBE-RAS extender can connect up to 8 FCD-E1LC devices to one management system.

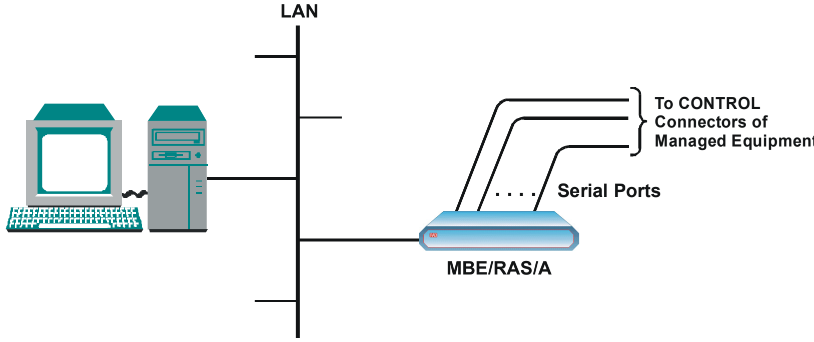


Figure 1-7. Basic Management Topology Using Network Management Station Attached to LAN

The dedicated management traffic routers of the FCD-E1LC systems, and of the other RAD equipment, are able to determine network topology in accordance with the capabilities of the routing algorithm, without requiring the user to provide a priori topology information on the network. Moreover, the routing algorithm also supports automatic switching to an alternate route in case the currently selected route fails. The dedicated router operates on the inband traffic; you can also enable the routing of out-of-band traffic.

Combining Inband and Out-of-Band Management Capabilities

The advanced capabilities of the FCD-E1LC SNMP agents allow easy integration of the FCD-E1LC system in wide-area managed communication systems. Its capabilities support any practical communication network topology, as illustrated in the example shown in *Figure 1-8*.

In *Figure 1-8,* the network management station attached to the FCD-E1LC system can manage, using inband communication over the user-selected links, all the units (another FCD-E1LC unit, and several Megaplex-2100 units), connected to the remote ends of the corresponding links. Thus, an entire wide-area network can be managed by means of a network management station connected to any FCD-E1LC unit (or to any of the other RAD equipment, which supports SNMP management).

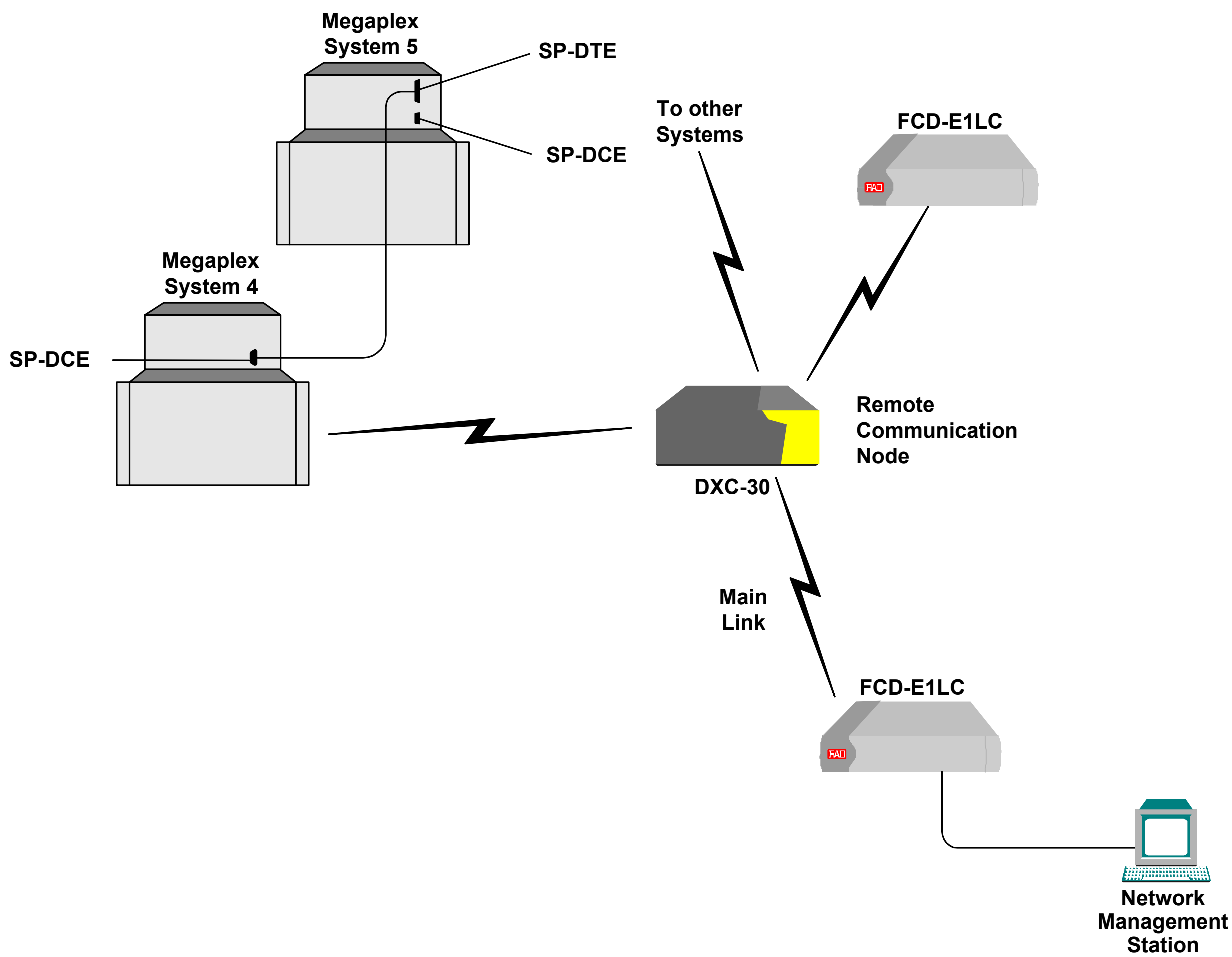


Figure 1-8. Extended Management Topology Using Network Management Stations

Remote Management using Telnet over IP

The FCD-E1LC system supports the Telnet communication protocol, which enables any IP host to access the FCD-E1LC system supervision facility using TCP/IP communication. The Telnet user has access to the same command-line interface that is available to the user of a supervision terminal, but it uses the management topologies described above for SNMP.

Prevention of Access Conflicts

The FCD-E1LC system has a dedicated mechanism that prevents access conflicts when more than one management mode is active.

Table 1-3 lists FCD-E1LC response to multiple-access conditions.

Table 1-3. Handling of Management Access Conflicts

Type of First Access	Response to Second Access		
	Telnet Inband	Telnet Out-of-Band	Supervision Terminal
Telnet Inband	Message	Ignored	Message
Telnet Out-of-Band	Message	Ignored	Ignored
Supervision Terminal	Disconnects the terminal	Not possible	Ignored

1.7 Technical Specifications

E1 Main and Sublinks

Compliance	ITU-T Rec. G.703, G.704, G.706, G.732, G.826
Framing	• G732N, 2 frames per multiframe, CRC-4 option disabled • G732N, 2 frames per multiframe, CRC-4 option enabled • G732S, 16 frames per multiframe, CRC-4 option disabled • G732S, 16 frames per multiframe, CRC-4 option enabled • Unframed
Data Rate	2.048 Mbps (±50ppm)
Line Code	HDB3
Interface Type	*Balanced or unbalanced, with automatic selection in accordance with the connected cable*
Line Impedance	
Balanced interface	120Ω
Unbalanced interface	75Ω
Transmit level	
Balanced Interface	±3V ±10%
Unbalanced Interface	±2.37V ±10%

	Receive level	
	LTU (long haul) mode	0 to -36 dB
	DSU (short haul) mode	0 to -10 dB
	Jitter Performance	Per ITU-T Rec. G.823
	Connector	RJ-45 (ISO 10173) 8-pin connector
	Timing	
	Receive timing	Always recovered from received line signal
	Transmit timing (user-selectable)	
	Internal	±50 ppm oscillator
	External timing	User-selectable source: • Locked to the transmit clock of the data channel • Locked to the recovered receive main link clock • Locked to the recovered receive clock of the sublink (optional) Allowed range: ±50 ppm
	Loopback timing	Locked to the recovered receive clock, allowed range ±50 ppm
Synchronous User Data Channels	*Data Channel Interface*	RS-530 (also supports V.35, V.36/RS-449), or X.21, according to order. V .35, V.36/RS-449, X.21 supported by means of adapter cables
	Data Channel Connectors	• RS-530 interface: 25-pin D-type female • V.35 interface: 34-pin female via adapter cable • V.36/RS-449 interface: 37-pin D-type female via adapter cable • X.21 interface: 15-pin, D-type female via adapter cable
	Data Rates	User-selectable, *n*×64 kbps or *n*×56 kbps, where *n* equals 1, 2, 3, ..., 31
	Timing Modes	

	DCE	Receive and transmit clocks to the synchronous DTE
	DTE1	Receive clock to the synchronous device, and transmit clock from the synchronous device
	DTE2	Receive and transmit clock from the synchronous DCE (not supported with the X.21 interface)
	Control Signals	• CTS follows RTS or constantly ON, software selectable • DSR constantly ON, except during the remote main link loopback • DCD constantly ON, except during loss of synchronization alarm on main link
	Timeslot Assignment	• Sequential timeslots (bundled) • User-defined
V.24 Asynchronous User Data Port	*Interface*	V.24
	Connectors	25-pin D-type female
	Bit Rates	64 kbps or 128 kbps. Allows operation opposite external user equipment at bit rates 1.2, 2.4, 4.8, 9.6, 19.2, or 38.4 kbps
	Timing Mode	DCE: receive and transmit clocks to the asynchronous DTE
	Control Signals	CTS follows RTS or constantly ON, software selectable DSR constantly ON, except during the remote main link loopback DCD constantly ON, except during loss of synchronization alarm on main link
	Timeslot allocation	Sequential timeslots (bundled) User-defined
Ethernet Port	*Compatibility*	Relevant sections of IEEE 802.3u, 802.3x, 802.1p and 802.3q
	Data Rate	• 10BaseT: 10 Mbps • 100Base-Tx: 100 Mbps • Auto-negotiation

	Internal LAN Traffic Processing	Ethernet switch with one external port, and one WAN port (toward the network, via the main link). Supports QoS using tag-based VLAN priority or IP ToS precedence
	LAN Table	2048 MAC addresses with configurable automatic aging (default – 5 minutes)
	Connector	RJ-45, shielded
Supervisory and Management Port	*Interface*	V.24/RS-232 (asynchronous)
	Port Connector	9-pin D-type female
	Data Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200 bps, with automatic detection of data rate (Autobaud)
	Data Word Format	• One start bit • 7 or 8 data bits • Even, odd, or no parity • One stop bit
	Dial-in Capabilities	Supports all the supervisory port functions
	Dial-out Capabilities	Automatic reporting of alarms to remote locations; alarms causing dial-out activities are user-selectable
Management		Full control over FCD-E1LC operation via the DCE CONTROL port, using supervision ("dumb") terminal, SNMP (SLIP), or Telnet (SLIP), remote monitoring and remote data collection
	Inband Remote Management	• Through timeslot 0 (any sequence of Sa4 through Sa8 bits) using proprietary protocol with dynamic routing • Through dedicated timeslot using reliable proprietary protocol
	Out-of-Band Remote Management	SLIP or PPP protocol

Diagnostics	*Test Loops*	• E1 main link local analog loopback • E1 main link local digital loopback • E1 main link remote analog loopback • E1 main link remote digital loopback • E1 sublink local analog loopback • E1 sublink local digital loopback • E1 sublink remote analog loopback • E1 sublink remote digital loopback • Data channel local loopback • Data channel remote loopback • BER test on selected timeslots of the main link • Inband FT1/FE1 code-activated loopback on the main link *Note*: No loopback can be activated for the Ethernet interface.
	Statistics Collection	As per ITU-T Rec. G.706, G.826 with local support as per RFC 4016
Alarms	*Alarm Buffer*	Alarm buffer size: 100 alarms. Last 100 alarms are stored and available for retrieval. Each alarm is time stamped (internal clock without battery backup – must be set to correct time after turn-off or power failure)
Indicators	*Front Panel Indicators*	PWR – FCD-E1LC is powered (green) SYNC LOSS LOC MAIN – Loss of local synchronization alarm on the main link (red) SYNC LOSS REM MAIN – Loss of remote synchronization alarm on the main link (red) SYNC LOSS LOC SUB – Loss of local synchronization alarm on the sublink (red) SYNC LOSS REM SUB – Loss of remote synchronization alarm on the sublink (red) TST – test active (yellow) ALM – alarm indication (red)
	Rear Panel Ethernet Interface Indicators	• LINK (green) – LAN link integrity • ACT (yellow) – LAN data activity • 100M – operation at 100 Mbps

Physical Characteristics	*Height*	43.7 mm (1.7 in) (1U)
	Width	43.2 cm (19 in)
	Depth	24.3 cm (9.5 in)
	Weight (approx.)	0.9 kg (2.0 lb)
Power	*Supply Voltage*	
	AC source	100 to 240 VAC, 50/60 Hz
	DC source	-48 VDC or -60 VDC (-40 to -72 VDC)
	Power Consumption	5W max.
Environment	*Operating Temperature*	0° to 50°C (32° to 122°F)
	Relative Humidity	Up to 90%, non-condensing

Chapter 2

Installation and Setup

2.1 Introduction

This chapter provides installation instructions for the FCD-E1LC.

The chapter presents the following information:

- Safety precautions for installation personnel and users
- Site requirements
- General description of equipment enclosures, the available interface options, and the FCD-E1LC panels
- Mechanical and electrical installation instructions for the FCD-E1LC
- Operation procedures (including turn-on, normal indications and turn-off).

After installing the system, it is necessary to configure it in accordance with the specific user's requirements. The preliminary system configuration is performed by means of a supervision terminal directly connected to the FCD-E1LC (procedures for using the terminal are given in *Chapter 3*). The software necessary for using the terminal is stored in the FCD-E1LC.

After the preliminary configuration and during routine operations, the FCD-E1LC can also be managed by means of Telnet hosts or SNMP-based network management stations, e.g., RADview. Refer to the User's Manual of the network management station for operating instructions; Telnet hosts use the supervision terminal procedures.

Safety Precautions

Warning

No internal settings, adjustment, maintenance, and repairs may be performed by either the operator or the user; such activities may be performed only by skilled service personnel who are aware of the hazards involved.

Always observe standard safety precautions during installation, operation, and maintenance of this product.

Grounding

For your protection and to prevent possible damage to equipment when a fault condition, e.g., a lightning stroke or contact with high-voltage power lines, occurs on the cables connected to the equipment, the FCD-E1LC unit must be properly grounded at any time. Any interruption of the protective (grounding) connection inside or outside the equipment, or the disconnection of the protective ground terminal can make this equipment dangerous. Intentional interruption is prohibited.

Note

Before installing the product, review Handling Energized Products *at the beginning of the manual.*

Before switching on this equipment and before connecting any other cable, the protective ground terminal of the FCD-E1LC must be connected to a protective ground. The grounding connection is made through the power cable. Therefore, the grounding arrangements depend on the equipment power supply source:

- AC-powered units: the power cable must always be inserted in a socket outlet provided with a protective ground contact, and the protective action must not be negated by use of an extension cord (power cable) without a protective conductor (grounding).
- DC-powered units: the power cable is connected to the FCD-E1LC power connector through an AC/DC Adapter (AD) available from RAD. Make sure to connect ground to the AD grounding terminal. The protective action must not be negated by use of an extension cord (power cable) without a protective conductor (grounding).

Whenever FCD-E1LC units are installed in a rack, make sure that the rack is properly grounded and connected to a reliable, low-resistance grounding system.

Warning

Dangerous voltages may be present on the cables connected to the FCD-E1LC.

- Never connect cables to an FCD-E1LC unit if it is not properly installed and grounded.
- Disconnect all the cables connected to the connectors of the FCD-E1LC before disconnecting the FCD-E1LC power cable.

Caution

The FCD-E1LC does not have a power on/off switch; therefore it will start operating as soon as it is connected to power.

Caution

FCD-E1LC contains components sensitive to ESD. To prevent ESD damage, do not touch the internal components or connectors.

If you are not using a grounded wrist strap, before touching or performing any internal settings on the FCD-E1LC, it is recommended to discharge the electrostatic charge of your body by touching the frame of a grounded equipment unit.

Whenever feasible, during installation works use standard ESD protection wrist straps to discharge electrostatic charges. It is also recommended to use garments and packaging made of antistatic materials or materials that have high resistivity, yet are not insulators.

It is also important to make sure that other equipment, in particular customer's data equipment connected to FCD-E1LC serial data and Ethernet ports, is properly grounded (connected to the protective, or safety, ground) before attempting to connect it to the FCD-E1LC.

2.2 Site Requirements and Prerequisites

Physical Requirements

The FCD-E1LC are intended for installation on desktop and shelves. All the connections are made to the rear panel.

For installation in 19-inch racks, RAD offers a rack mount (RM) kit. An FCD-E1LC installed with the RM kit occupies a height of 1U. For installation of one or two units in a 19-inch rack, refer to the *Rack Mounting Kit for 19-inch Racks* guide that comes with the RM kit.

Power Requirements

FCD-E1LC has a wide range AC/DC power supply, and therefore can be powered either by AC or DC sources:

- AC-powered FCD-E1LC units should be installed within 1.5m (5 feet) of an easily-accessible grounded AC outlet capable of furnishing 100 to 240 VAC, 50/60 Hz (nominal mains voltage).
- DC-powered FCD-E1LC units require a -48 VDC or -60 VDC (nominal) power source.

Caution Reversing the DC supply voltage polarity will not damage the FCD-E1LC, but the internal protection fuse will not function.

Connections

This section presents general requirements regarding the connections to the various FCD-E1LC interfaces. Note that your unit cannot include all the interfaces listed below.

If you need specific information regarding pin allocations in the FCD-E1LC interface connectors and wiring data for adapter cables, refer to *Appendix A*.

Main and Sublink Connections

FCD-E1LC main and sub ports support two interfaces: 120Ω balanced interface for operation over two twisted pairs, and 75Ω unbalanced interface for operation

over coaxial cables. Both interfaces are terminated in an RJ-45 eight-pin connector.

At any time, only one interface is active. The selection of the interface is automatically made, in accordance with the cable connected to the port:

- The cable used for connecting to equipment with balanced E1 interface should include only two twisted pairs, one for the transmit path and the other for the receive path.

Note *One of the contacts in the E1 port connectors is used to sense the connection of the unbalanced adapter cable (see below). Therefore, do not connect cables with more than two pairs when you want to use the balanced interface.*

- To connect to equipment with unbalanced E1 interface, it is necessary to convert the FCD-E1LC RJ-45 connector to the standard pair of BNC female connectors used for unbalanced E1 interfaces. For this purpose, RAD offers 15 cm long adapter cables: CBL-RJ45/2BNC/E1/X for the main link port and CBL-RJ45/2BNC/E1 for the sublink port. These cables have one RJ-45 plug for connection to FCD-E1LC connector and two BNC female connectors at the other end.

  Connecting the cable to the FCD-E1LC main or sublink connector will cause the corresponding interface to switch to the unbalanced mode.

The FCD-E1LC main and sub interfaces must not be directly connected to unprotected public telecommunication networks. The connection to such networks must be made through a network termination unit that provides separation between the interface conductors and the telecommunication network conductors in accordance with the applicable local regulations.

Serial Data Port Connections

The serial data ports of FCD-E1LC are terminated in a 25-pin D-type female connector. The interface type is RS-530 (which also supports X.21), V.36/RS-449, V.24, or V.35, according to the order.

- When using the RS-530 or V.24 interface, equipment with RS-530 or, respectively, V.24 interface can be directly connected to the data channel connector using standard cables.
- For the X.21 interface, an adapter cable, terminated in a 15-pin D-type female connector, is needed.
- For the V.35 interface, an adapter cable, terminated in a 34-pin female connector, is needed.
- For the V.36/RS-449, an adapter cable, terminated in a 37-pin D-type female connector, is needed.

Ethernet Port Connections

The optional Ethernet port has a 10/100Base-T Ethernet interface terminated in an RJ-45 connector, designated 10/100BASE-T.

The port supports automatic MDI/MDIX detection and cross-over, and therefore can be connected by any type of cable (standard or crossed) to any type of 10/100Base-T Ethernet port (station or hub).

CONTROL DCE Port Connections

The CONTROL DCE supervisory port has a 9-pin D-type female connector with RS-232 interface.

The interface (DCE or DTE) is software-selectable. The default selection, DCE, enables direct connection to terminals and management stations; when the interface is configured as DTE, it is necessary to use a crossed adapter cable.

Front and Rear Panel Clearance

Allow at least 90 cm (36 inches) of frontal clearance for operator access.

Allow at least 10 cm (4 inches) clearance at the rear of the unit for interface cable connections. However, during installation, replacement, and cable connections, at least 90 cm (36 inches) is needed.

Ambient Requirements

The ambient operating temperature of the FCD-E1LC is 0 to 50°C (32 to 122°F), at a relative humidity of up to 90%, non-condensing.

The FCD-E1LC units are cooled by free air convection; therefore, in rack installations it is necessary to leave sufficient space (at least 1U) above and below each unit, to enable free airflow.

2.3 Package Contents

The FCD-E1LC package includes the following items:

- FCD-E1LC unit
- Multiservice Access Devices and Intelligent CLEs CD-ROM
- AC power cord or AC/DC adapter plug (if ordered)
- Rack-mount (RM) kit (if ordered)
- Interface adapter cable(s), in accordance with order.

2.4 Equipment Needed

The cables you need to connect to the FCD-E1LC depend on the FCD-E1LC application. You can use standard cables or prepare the appropriate cables yourself in accordance with the information given in *Appendix A.*

Table 2-1 lists the cables available from RAD for connection of the FCD-E1LC user synchronous data port to user's equipment with DTE interfaces. Contact RAD Technical Support Department if other interface cables are necessary.

Table 2-1. Interface Adapter Cables for FCD-E1LC Data Ports

Cable	User Interface	Clock Mode	Length (m / ft)
CBL-HS2/V/1	V.35	DCE	2 / 6
CBL-HS2/V/2	V.35	DTE1	2 / 6
CBL-HS2/V/3	V.35	DTE2	2 / 6
CBL-HS2/R/1	V.36/RS-449	DCE	2 / 6
CBL-HS2/R/2	V.36/RS-449	DTE1	2 / 6
CBL-HS2/R/3	V.36/RS-449	DTE2	2 / 6
CBL-HS2/X/1	X.21	DCE	2 / 6

In addition, when using the unbalanced interface for the main and sublink ports, you may need adapter cables, CBL-RJ45/2BNC/E1/X and CBL-RJ45/2BNC/E1, respectively. When using the balanced interface, use cables wired point-to-point, consisting of two twisted pairs and terminated in RJ-45 connectors.

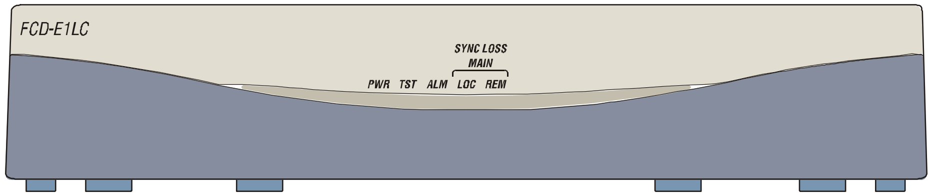
2.5 FCD-E1LC Enclosures

This section presents a physical description of the various versions of FCD-E1LC units.

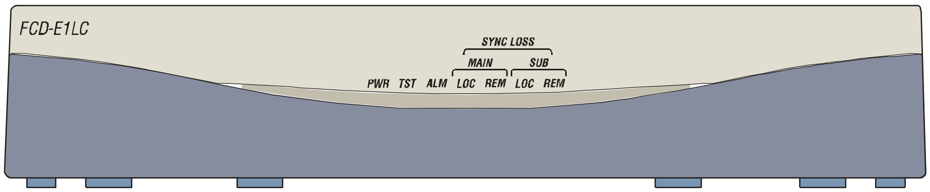
FCD-E1LC Front Panel

Figure 2-1 shows typical FCD-E1LC front panels. The front panel includes only the FCD-E1LC indicators.

Table 2-2 explains the functions of the indicators located on the FCD-E1LC front panel.



A. FCD-E1LC without Sublink



B. FCD-E1LC with Sublink

Figure 2-1. Typical FCD-E1LC Front Panels

Table 2-2. FCD-E1LC Front Panel Indicators

Indicator	Function
PWR Indicator (green)	Lights when the FCD-E1LC is powered
TST Indicator (yellow)	Lights when a test is active
ALM Indicator (red)	Flashes to indicate that a major alarm condition is present in the system. Lights to indicate that the most severe alarm condition present in the system is a minor alarm
SYNC LOSS – MAIN LOC Indicator (red)	Lights to indicate local loss of synchronization on the main link
SYNC LOSS – MAIN REM Indicator (red)	Lights to indicate that a remote loss of synchronization indication has been received by the main link interface
SYNC LOSS – SUB LOC Indicator (red)	Lights to indicate local loss of synchronization on the sublink
SYNC LOSS – SUB REM Indicator (red)	Lights to indicate a remote loss of synchronization indication has been received by the sublink interface

FCD-E1LC Rear Panels

The components located on the FCD-E1LC rear panels depend on the ordered interfaces.

Figure 2-2 shows several typical rear panels of FCD-E1LC units. *Table 2-3* explains the functions of the rear panel components.

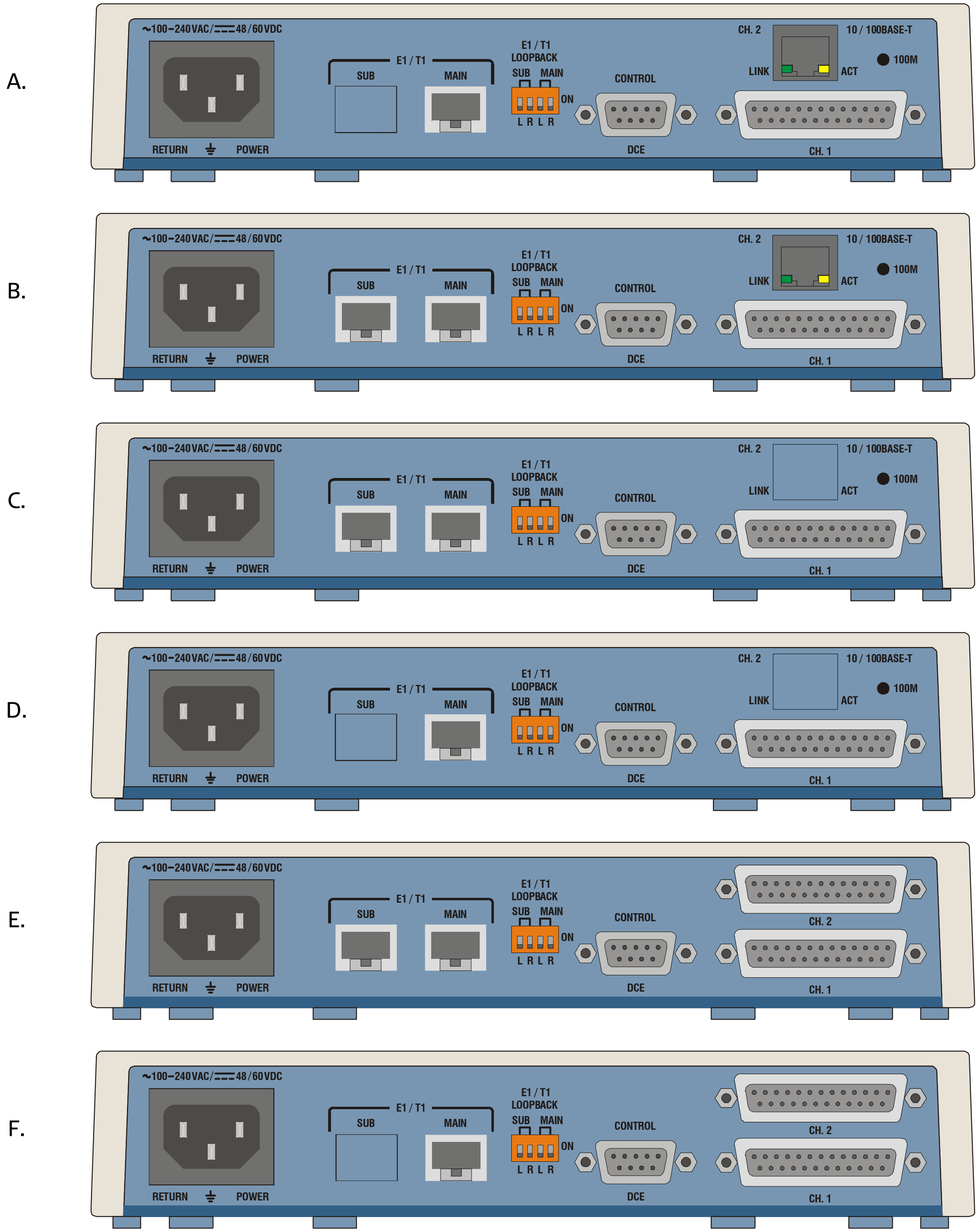


Figure 2-2. Typical FCD-E1LC Rear Panels

Table 2-3. FCD-E1LC Rear Panel Components

Item	Function
POWER Connector	Power connector, for connection of the supply voltage (either AC or DC)
CH.1 Connector	25-pin D-type female connector, for connection to the channel 1 data port (interface type depends on ordering option)
CH.2 Connector	25-pin D-type female connector, for connection to the optional channel 2 data port (interface type depends on ordering option)
CH.2 10/100BASE-T Connector	RJ-45 connector for connection to the optional Ethernet LAN port, which has a 10/100Base-T interface
CH.2 10/100BASE-T LINK Indicator	Green indicator located in the CH.2 10/100BASE-T connector: • Lights steadily when the LAN port detects the link integrity signal (normal condition when there is no data activity) • Off when the port does not detect the link integrity signal
CH.2 10/100BASE-T ACT Indicator	Yellow indicator located in the CH.2 10/100BASE-T connector, flashes or lights when the LAN port transmits or receives data (normal operating condition)
CH.2 10/100BASE-T 100M Indicator	Green indicator for the optional LAN port: • Lights steadily when the LAN port operates at a data rate of 100 Mbps • Off when the LAN port operates at a data rate of 10 Mbps
E1/T1 MAIN Connector	RJ-45 connector for connection to the main link interface
E1/T1 SUB Connector	RJ-45 connector for connection to the optional sublink interface
CONTROL DCE Connector	9-pin female D-type connector for connection to the FCD-E1LC supervisory terminal port
E1/T1 LOOPBACK Selector	4-section switch, controls the main and sublink analog test loopbacks. For a description of the loopbacks, refer to *Chapter 4*. **Section** – **Function** **SUB L** – Controls the sublink analog local loopback. **SUB R** – Controls the sublink analog remote loopback. **MAIN L** – Controls the main link analog local loopback. **MAIN R** – Controls the main link analog remote loopback. To change the state of a loopback: • To activate a loopback using this switch, set the corresponding switch section to ON. The TST indicator on the front panel will light. • To deactivate a loopback, return the switch to OFF. If no other test is active on the FCD-E1LC, the TST indicator on the front panel will turn-off. Note that the same activities can be performed by management (for example, using the supervisory terminal). The actual state of a loopback is therefore determined by the last command (either from the management or the switch).

2.6 Setting the Internal Jumpers and Switches

Caution Before starting, review the safety and ESD precautions given in *Section 2.1*.

The FCD-E1LC preliminary configuration is performed by means of a supervisory terminal. To protect against unauthorized use, you must enter a password before you can start using the supervisory terminal.

In case you do not know the password and/or the communication parameters of the serial supervisory port, it is necessary to restore the default values before you can start configuration activities.

The FCD-E1LC includes an internal switch (marked SW2 on the FCD-E1LC main printed circuit board) that controls the loading of the default parameters.

This section presents instructions for reaching the internal switch.

Note *If you can use the supervisory terminal to enter the INIT DB command, you may skip this section.*

It is also recommended to check the settings of the internal switch in case the configuration data prepared by you is lost after resetting (or turning off and on again) the FCD-E1LC: usually, this indicates that the FCD-E1LC switch is set to reload the factory-default parameters upon power-up.

Note *For some FCD-E1LC hardware versions, it is not necessary to open the enclosure to reach the switch: in these versions, the switch is located under the main printed circuit board and can be accessed by opening a small cover on the bottom of the FCD-E1LC case.*

➤ To reload the default parameters by means of the internal switch:

1. Open the FCD-E1LC enclosure as explained below.
2. Set the INIT_DB section of switch SW2 to ON.
3. Arrange the FCD-E1LC for safe operation with the cover open.
4. Connect power to the FCD-E1LC.
5. Wait about 2 minutes, and then disconnect the power from the FCD-E1LC.
6. Set the INIT_DB section of switch SW2 to OFF.
7. Close the FCD-E1LC cover as explained on page *2-14*.

Opening the Unit

➤ To open the FCD-E1LC enclosure:

1. Refer to *Figure 2-3* and open the screws that fasten the FCD-E1LC cover. Keep screws in a safe place, for reuse.

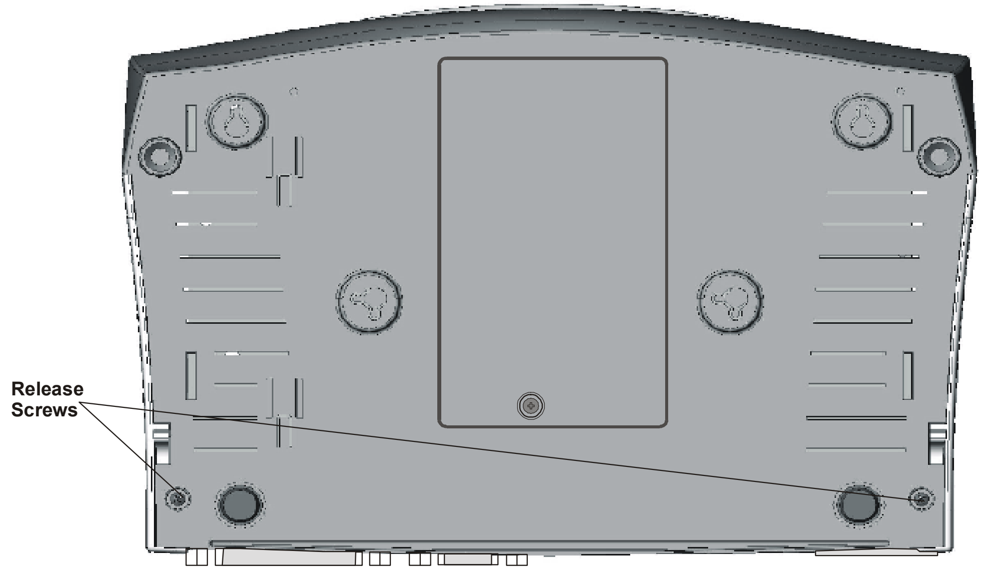


Figure 2-3. FCD-E1LC Cover Screws

2. Refer to *Figure 2-4* and release the cover catches as illustrated in the figure. If pushing the catches with the nails of your fingers is difficult, you may use a narrow-blade screwdriver.

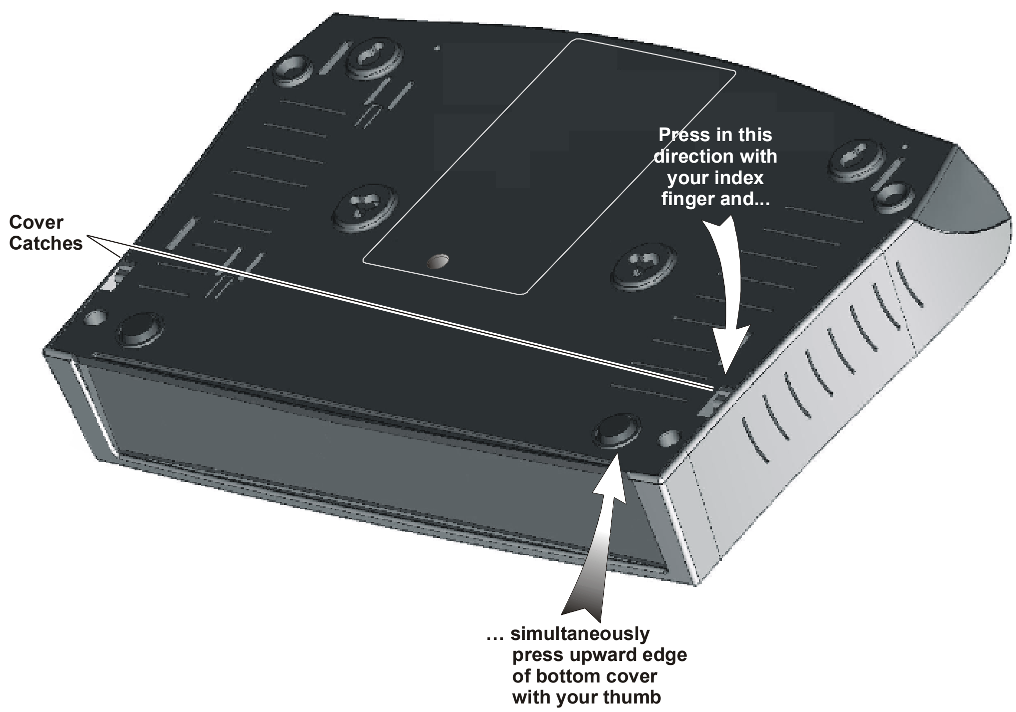


Figure 2-4. Releasing FCD-E1LC Cover Catches

3. After catches are released, the cover easily slides off. *Figure 2-5* shows a general view of a typical FCD-E1LC unit after cover is removed.

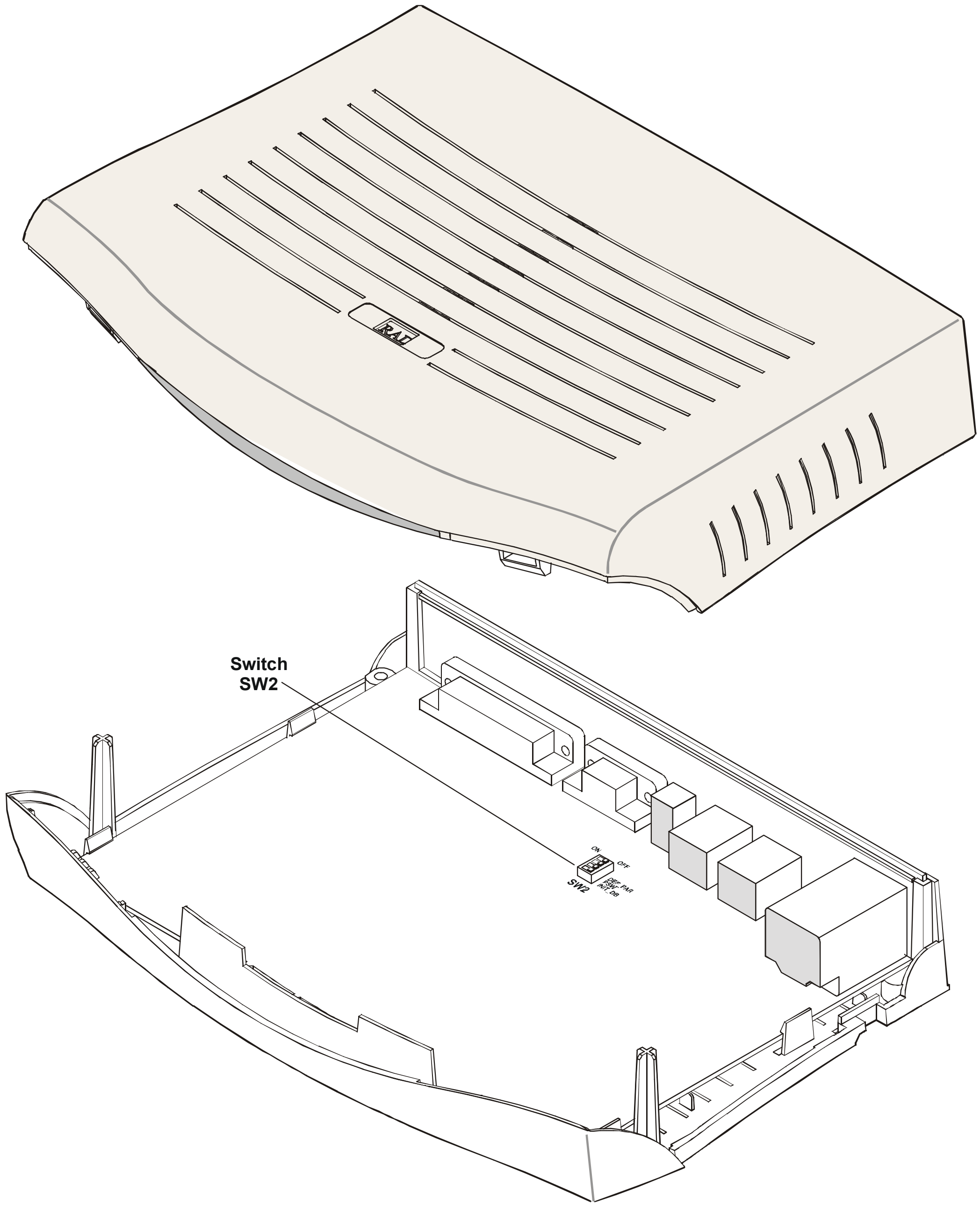


Figure 2-5. FCD-E1LC, General View After Cover is Removed

➤ To check and change internal switch SW2:

1. Refer to *Figure 2-6* and identify the location of the SW2 switch.

Note

In addition to switch SW2 identified in these figures, the FCD-E1LC boards include additional switches and jumpers that are preset by the manufacturer and must not be moved.

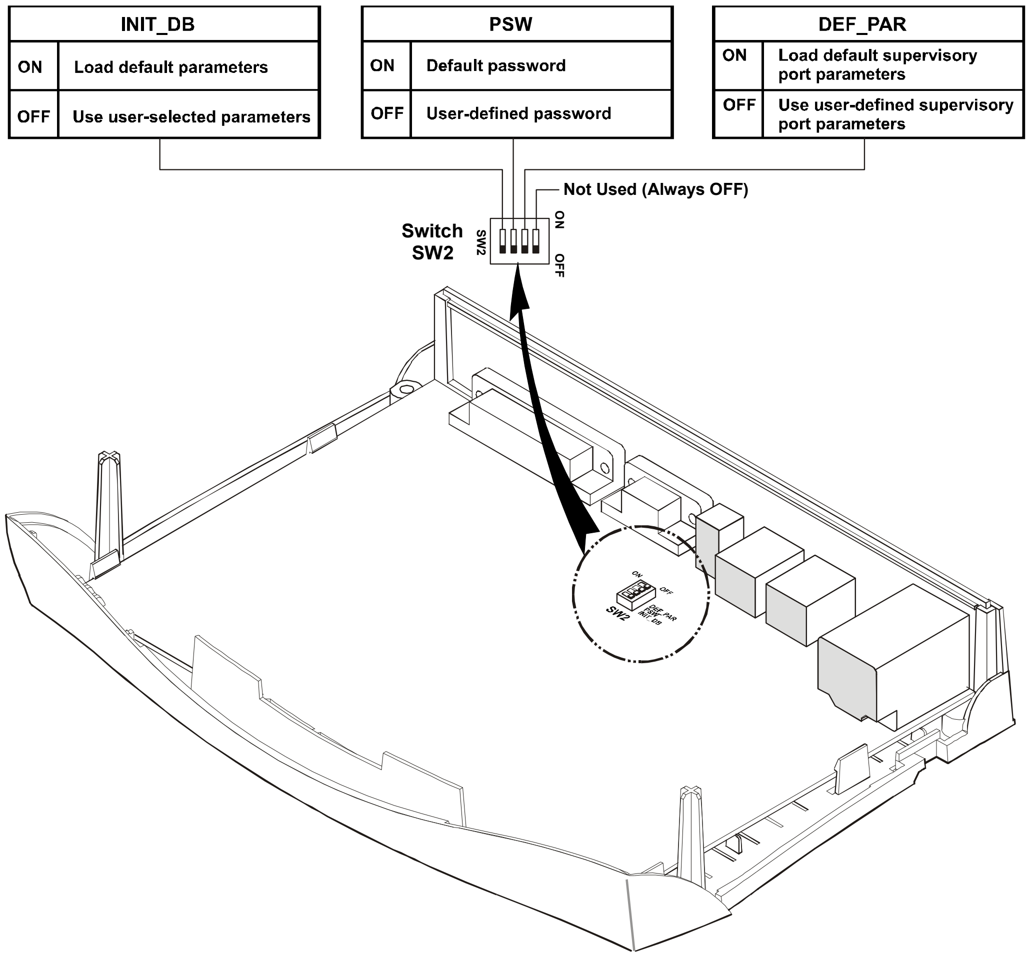


Figure 2-6. FCD-E1LC, Location of Switch SW2

2. The functions of SW2 switch sections are explained in *Table 2-4*. Check and if necessary change the positions of the various sections in accordance with your requirements.

Table 2-4. Switch SW2 Functions

Section	Function
INIT_DB	This section selects the source of the configuration database parameters. FCD-E1LC is delivered with its configuration database loaded with the factory default parameters. You can select this position again to restart with the default parameters in case the current values are not known. ON FCD-E1LC loads the factory-default parameters upon power-up. OFF FCD-E1LC loads the user-selected parameters from its non-volatile memory on power-up. Default: OFF ***Note:*** *User-selected parameter values are not erased by setting the DB INIT section to ON. Only after FCD-E1LC is turned off and then powered again, do the default values replace the user values.*

Table 2-4. Switch SW2 Functions (Cont.)

Section	Function
PSW	FCD-E1LC is delivered with a default password, RAD. However, to prevent unauthorized personnel from using the FCD-E1LC supervision program, you can use a password of your own. ON FCD-E1LC uses the default password. OFF FCD-E1LC uses the user-defined password. Default: OFF The FCD-E1LC polling address (node number) is also affected by the PSW section: with this section set at ON, the node number is set to 0. Upon first-time operation, it is recommended to use the ON position to start the configuration. You can select this position again to restart with the default password and node address 0 in case the current user password was lost. *Note* *You can use the DEF SP command to cancel password protection. In this case, no password is used, irrespective of the position of this switch section.*
DEF PAR	This section selects the source of the supervisory port parameters. ON FCD-E1LC loads the factory-default supervisory port parameters (automatic detection of any standard data rate in the range of 1200 to 115,200 bps, one start bit, 8 data bits, no parity, one stop bit, terminal mode). OFF Supervisory port operates according to user-defined parameters. Default: OFF *Note* *User-selected parameter values are not erased by setting one or more sections of switch SW2 to ON: this action merely causes FCD-E1LC to use the default values. However, if FCD-E1LC is powered off and then on again, the default values replace the user values.*

Closing the Unit

➤ To close FCD-E1LC enclosure:

1. Refer to *Figure 2-7*, and place cover as shown.

Figure 2-7. Closing the FCD-E1LC Cover

2. Push cover in the direction shown in *Figure 2-7*, until you hear the cover catches click as they lock the cover in place.
3. Refer to *Figure 2-3* and fasten the cover with its screws.

Installing FCD-E1LC in a Rack

FCD-E1LC units are intended for installation on desktops, shelves or in 19-inch racks. Do not connect power to the enclosure before it is installed in the designated position.

For rack installation, a rack mount (RM) kit, is available from RAD. Refer to the RM installation leaflet for detailed instructions.

2.7 Connecting the Cables

Before starting, refer to the site installation plan and identify the cables intended for connection to this FCD-E1LC unit. For general information regarding connections, refer to *Section 2.2.*

Connecting the Main Link

➤ To connect the FCD-E1LC main link to equipment with balanced interface:

- Use a straight (point-to-point) cable terminated in RJ-45 connectors to connect the FCD-E1LC RJ-45 connector designated E1/T1 MAIN to the designated equipment connector.

Note *One of the contacts in the E1 main port connector is used to sense the connection of the unbalanced adapter cable (see below). Therefore, do not connect cables with more than two pairs when you want to use the balanced interface.*

➤ To connect the FCD-E1LC main link to equipment with unbalanced interface:

1. Connect the RJ-45 connector of the CBL-RJ45/2BNC/E1/X adapter cable to the FCD-E1LC RJ-45 connector designated E1/T1 MAIN.
2. Connect the coaxial cables from the other equipment to the two BNC connectors at the other end of the adapter cable. Pay attention to correct connection:
   - Connect the cable from the user's equipment transmit output to the green BNC connector (main link receive input)
   - Connect the cable from the user's equipment receive input to the red BNC connector (main link transmit output).

Connecting the Sublink

➤ **To connect equipment with balanced interface to the FCD-E1LC sublink:**

- Use a straight (point-to-point) cable terminated in RJ-45 connectors to connect the designated equipment connector to the FCD-E1LC RJ-45 connector designated E1/T1 SUB.

Note *One of the contacts in the E1 sub port connector is used to sense the connection of the unbalanced adapter cable (see below). Therefore, do not connect cables with more than two pairs when you want to use the balanced interface.*

➤ **To connect equipment with unbalanced interface to the FCD-E1LC sublink:**

1. Connect the RJ-45 connector of the CBL-RJ45/2BNC/E1 adapter cable to the FCD-E1LC RJ-45 connector designated E1/T1 SUB.
2. Connect the coaxial cables from the other equipment to the two BNC connectors at the other end of the adapter cable. Pay attention to correct connection:
   - Connect the cable from the user's equipment receive output to the green BNC connector (sublink transmit input)
   - Connect the cable from the user's equipment transmit input to the red BNC connector (sublink receive output).

Connecting the Data Channels

Each serial data port of the FCD-E1LC is terminated in a 25-pin D-type female connector. The interface type is RS-530 (also supporting X.21) or V.35, according to order.

The required cables can be prepared in accordance with the port connector wiring information given in *Appendix A*, or ordered separately from RAD. See list of cables available from RAD in *Section 2.4*.

When using adapter cables, first connect the adapter cable to the FCD-E1LC data channel connector, and then connect the user's data cable to the adapter connector.

Connecting Ethernet

Identify the cable intended for connection to the 10/100Base-T connector. Connect the cable to the corresponding module connector.

Use a standard (station) cable wired point-to-point for connection to any type of Ethernet port (hub or station).

Connecting the CONTROL DCE Port

The front panel CONTROL DCE supervisory port has a 9-pin D-type female connector with RS-232 interface. The interface (DCE or DTE) is software-selectable:

- When the interface is configured as DCE, enables direct connection to terminals and management stations
- When the interface is configured as DTE, it is necessary to use a crossed adapter cable.

Caution Cables used for the CONTROL DCE port connection must have a frame ground connection. Use ungrounded cables when connecting a supervisory terminal to a DC-powered unit with floating ground. Using improper terminal cable may result in damage to the CONTROL DCE port.

2.8 Connecting to Power

Any interruption of the protective (grounding) conductor (inside or outside the device) or disconnecting the protective earth terminal can make the device dangerous. Intentional interruption is prohibited.

Warning Before switching this FCD-E1LC unit on and before connecting any other cable, FCD-E1LC protective earth terminals must be connected to protective ground. This connection is made through the DC or AC power cable. The AC power cord plug should only be inserted in an outlet provided with a protective ground (earth) contact, whereas when using DC power it is necessary to ground the AD grounding terminal. The protective action must not be negated by use of an extension cord (power cable) without a protective conductor (grounding).

Dangerous voltages may be present on the cables connected to the FCD-E1LC:

- Never connect cables to an FCD-E1LC unit if it is not properly installed and grounded. This means that its power cable must provide a protective ground (earth) contact before connecting any user or main link cable to the FCD-E1LC.
- Disconnect all the cables connected to the connectors of the FCD-E1LC before disconnecting the FCD-E1LC power cable.

Caution FCD-E1LC does not have a power on/off switch, and therefore it will start operating as soon as power is applied. It is recommended to use an external power on/off switch to control the connection of power to the FCD-E1LC. For example, the circuit breaker used to protect the supply line to the FCD-E1LC may also serve as the on/off switch.

AC power should be supplied to the FCD-E1LC through the 5-foot (1.5m) standard power cable terminated in a standard 3-prong plug.

The connection of the FCD-E1LC to a DC power source is made by means of a cable terminated in the AC/DC adapter (AD) plug.

➤ To connect AC power:

1. Connect the AC power cable to the FCD-E1LC power connector.
2. Insert the plug at other end of the AC power cable into a socket (outlet) with a protective ground contact. If power is connected, the PWR indicator of the FCD-E1LC will light.

➤ To connect DC power:

- Refer to the DC power supply connection supplement for instructions how to wire the DC cables. The DC supplement is provided on the technical documentation CD supplied with the unit.

Chapter 3

Operation

3.1 Turning On the Unit

➤ To turn on the unit:

1. Before first-time turn-on, check that the installation and the required cable connections have been correctly performed in accordance with the instructions given in *Chapter 2*.
2. Set all the sections on the rear panel E1/T1 LOOPBACK switch to OFF.
3. To enable monitoring the FCD-E1LC during power-up and preliminary configuration procedures, it is recommended to connect a terminal to the CONTROL DCE connector of the FCD-E1LC.

   Any standard ASCII terminal (dumb terminal or personal computer emulating an ASCII terminal) equipped with an RS-232 communication interface can be used to control the FCD-E1LC operation. For best results, use VT-100 terminal emulation. To monitor the power-up process, configure the terminal for any rate supported by the FCD-E1LC (1200 to 115200 bps), one start bit, eight data bits, no parity, and one stop bit. Select the full-duplex mode, echo off, and disable any type of flow control.

Caution FCD-E1LC does not have a power on/off switch, and therefore it will start operating as soon as power is applied.

4. Connect power to the FCD-E1LC.
5. The FCD-E1LC PWR indicator turns on; the other indicators turn-on for a start time, and then turn-off.
6. Wait for the completion of the power-up self-test and initialization. This takes about one minute.
7. Press <CR> several times in sequence to establish communication with the FCD-E1LC. The terminal will then display various messages during the power-up.

   A typical display, which notifies you of the results of its power-up self-test is shown below:

   ```
   FCD Self Test in Progress ... OK
   ```

   or

   ```
   FCD Self Test in Progress ... Failed
   ```

   In the latter case, you must repair or replace FCD-E1LC before you can continue using it.

8. If FCD-E1LC successfully passed the power-up self-test, it sends the following message:

   `FCD Supervisory Port On Line. Type 'H' For Help`

   Now FCD-E1LC is ready for operation.

Note *If the configuration data stored by FCD-E1LC is corrupted, FCD-E1LC reports that the self-test has failed or sends the* **`DATABASE CHECKSUM ERROR`** *alarm message.*

In this case, you will have to load the default configuration. To do this, either enter the INIT DB command from the terminal or use the internal switch SW2 as explained in Chapter 2*.*

3.2 Indicators

Front Panel Indications

Note *For a description of FCD-E1LC front panel indicator functions, see* *FCD-E1LC Front Panel on page 2-3* .

As long as the FCD-E1LC is powered, the PWR indicator lights steadily.

During normal operation, the ALM, all the SYNC LOSS, and the TST indicators must be off.

Any alarm condition causes the ALM indicator to light (for major alarms, it will flash). Use the supervision terminal to read the alarm messages.

If any of the main link alarm indicators or the TST indicator lights, data transfer is interrupted.

The TST indicator lights when a test is activated. If the test is activated from the local FCD-E1LC, see the test type using the supervision terminal (**`DSP ST CH1, DSP ST CH2, DSP ST ML`** or **`DSP ST SL`**). You can disconnect a local loop by means of the **`CLR LOOP`** command, as explained in *Appendix D*.

Ethernet Interface Status Indications

If the FCD-E1LC optional Ethernet port is not yet connected to an active LAN, the LINK indicator is off.

After the connection is made and the auto-negotiation process is successfully completed:

- The LINK indicator lights steadily
- The ACT indicator lights steadily or flashes at the rate of the traffic flow through the FCD-E1LC LAN interface
- The 100M indicator indicates the actual operating rate: off for 10 Mbps, on for 100 Mbps.

3.3 Configuration and Management Alternatives

Before an FCD-E1LC unit can be used in its intended application, it is necessary to perform two types of activities:

- Preliminary configuration: its purpose is to prepare the FCD-E1LC unit for using any of the supported management facilities.
- System configuration: its purpose is to specify the system operational parameters needed by the FCD-E1LC to fulfill its intended function in the user's environment.

Preliminary Configuration

The preliminary configuration of the FCD-E1LC unit must always be performed using an ASCII terminal equipped with an RS-232 communication interface, directly connected to the FCD-E1LC supervisory port (the CONTROL DCE connector). The ASCII terminal can be a standard "dumb" communication terminal, or a personal computer running a terminal emulation or communication program.

System Configuration

FCD-E1LC operating mode is determined by a set of parameters stored in the internal non-volatile memory. To select these parameters, use the FCD-E1LC supervision terminal.

Note *If you make a configuration error (for example, you select a parameter value that conflicts with the current operating mode), FCD-E1LC rejects the erroneous selection and displays an error message that identifies the error.*

After the operating parameters have been loaded (a process called *configuration setup*), FCD-E1LC no longer requires operator attendance.

The configuration stored in the FCD-E1LC memory is not affected when power is turned off. Upon turn-on, FCD-E1LC checks the validity of the stored configuration data, and after the self-test, takes the last selected configuration. If the configuration does not require modification, FCD-E1LC is ready for operation immediately after power is applied. However, if the configuration data is corrupted, FCD-E1LC loads a default configuration prepared by the manufacturer instead.

After performing the preliminary configuration, you can configure the FCD-E1LC unit using any of the following options:

- Use the terminal as a supervision terminal, for performing all the management activities supported by the FCD-E1LC unit.
- Configure the FCD-E1LC unit from any IP host using the Telnet protocol. After establishing a Telnet session with the FCD-E1LC unit, the Telnet protocol offers the same functionality as the supervision terminal, and in addition enables remote access over IP networks.

Typically, the Telnet host is a PC or a UNIX station with the appropriate suite of TCP/IP protocols. The host can be directly connected to the managed FCD-E1LC unit. However, the host may also be located at a remote site, the only requirement being that IP communication be established between that site and the managed FCD-E1LC unit (either out-of-band through a separate network, using the SLIP or PPP protocol, or inband through the main and/or sublink).

- Configure the FCD-E1LC unit by means of SNMP-based network management stations.

Routine Management

During regular operation, the FCD-E1LC unit can be managed using any of the options listed above for system configuration.

Supervisory Terminal Characteristics

Any standard ASCII terminal ("dumb" terminal or personal computer emulating an ASCII terminal) equipped with a V.24/RS-232 communication interface can be used to control FCD-E1LC operation.

Control Port Interface Characteristics

FCD-E1LC has a V.24/RS-232 asynchronous DCE port, designated CONTROL DCE and terminated in a 9-pin D-type female connector. The control port continuously monitors the incoming data stream and will immediately respond to any input string received through this port. Moreover, when the FCD-E1LC control port is configured to support the SLIP or PPP protocol, messages in each of the supported protocols are automatically identified and processed.

The supervisory terminal can be connected to the FCD-E1LC control port either directly, or through a modem or any other type of full-duplex data link:

- For direct connection to the control port, use a straight-through cable.
- For connection to the control port through a modem or data link, use a cross-cable (also called null modem cable).

FCD-E1LC can communicate with the supervision terminal or modem at rates of 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200 bps. The word format consists of one start bit, 8 data bits, and one or two stop bits. Parity can be odd, even or disabled.

Always make sure the communication interfaces of the terminal/modem and the FCD-E1LC are configured for operation with the same parameters.

Modems

The CONTROL DCE port also supports the connection of a remote supervision terminal through a modem or low-speed data link: in this case, configure the control port interface as DTE and use a cross-cable (also called null modem cable) to connect to the CONTROL DCE port.

FCD-E1LC supports two types of modems:

- Dial-up Hayes™ compatible modems. FCD-E1LC has call-in and call-out capabilities; that is, it can accept external calls and initiate calls in order to report alarms.
- Multidrop modems, such as the RAD SRM-8 miniature multidrop modem. The multidrop configuration can be used to connect the supervisory ports of several FCD-E1LC units located in close proximity to a common supervision terminal, using multidrop modems (or digital sharing devices): these devices enable to connect a single terminal to many FCD-E1LC units.

  For multidrop operation, each FCD-E1LC unit must be assigned a node address in the range of 1 through 255.

Note *FCD-E1LC units also support address 0: assigning address 0 to an FCD-E1LC unit means that it will accept and answer any message: this is not permitted in multidrop operation. Address 0 is however recommended for use both with direct connections, and point-to-point or dial-up modem links.*

Control Port Handshaking Protocol with Supervision Terminals

The handshaking between the FCD-E1LC and the supervision terminal uses the control lines in the CONTROL DCE supervisory port connector. Since the interface mode is selected by software, the direction of the interface signals is the same in both the DCE and DTE mode, and a cross-cable is required for the DTE mode.

The control lines in DCE and DTE modes and the direction of the control signals are detailed in *Table 3-1*.

Table 3-1. Control Port Handshaking Protocol

Control Line	Interface Type		Function
	DCE	DTE	
CTS	Out	Not Used	Clear to Send line. The state of the CTS line is determined by user's configuration: • ON – The CTS line is always ON (active). • =RTS – The CTS line follows the RTS line.
DCD	Out	Out	Data Carrier Detect line. The state of the DCD line depends on the communication address (node number): • When the node address is 0, the DCD line is always ON (active). • When a non-zero node address is used, the DCD line becomes ON (active) when data is detected on the RD line, provided the FCD-E1LC recognizes its own address in the data stream. To simulate DTE operation, the delay between these events can be set by the user (by means of the DCD DELAY parameter).

Control Line	Interface Type		Function
	DCE	DTE	
DSR	Out	Out	Data Set Ready line. The state of the DSR line is user-configurable. • Usually, the DSR line is configured to track the DTR line. In this case, if the control port interface is DTE, the DSR line will be set to ON for five seconds when the RI line is ON while the DTR line is OFF. • If the control port interface is DCE, the DSR line can also be configured to be continuously ON. However, if the DTR line switches to OFF, the DSR line will also switch to OFF for 5 seconds. In addition, FCD-E1LC always sets DSR OFF (inactive) for 5 seconds when the EXIT command is executed or the disconnect time-out expires.
DTR	In	In	Data Terminal Ready line. The terminal sets the DTR line ON (active) to gain control over FCD-E1LC and start a configuration/monitoring session. When you end the terminal control connection, the DTR line will switch to OFF (becomes inactive).
RI	Not Used	In	Ring Indication line. The RI line is used only with dial-up modems (INT = DTE). The RI line is normally OFF (inactive), and switches to the ON (active) state when the modem, attached to the FCD-E1LC front-panel CONTROL DCE connector, detects an incoming call.
RTS	In	In	Request to Send line. The RTS line is normally ON (active) when the supervisory terminal is in session. When the RTS line is OFF (inactive), FCD-E1LC interprets any data received from the terminal on the transmit input (TD) line as MARK.

Autobaud Function

When the Autobaud function is enabled, FCD-E1LC identifies the operating data rate of the supervisory terminal by analyzing the timing of three consecutive Enter + Line Feed characters (generated by pressing three times the <Enter> key). The detected data rate is then used for the current communication session.

The automatic baud rate identification procedure is performed (or repeated) whenever three consecutive <Enter>s are received after one of the following events occurs:

- The DTR line has been switched off.
- The EXIT command has been executed.
- The idle disconnect timeout expired because no data has been exchanged with the supervisory terminal.

In case one of these events occurred, FCD-E1LC assumes that the current communication session has been terminated.

Note *You must disable the Autobaud function if you intend to use SLIP or PPP communication.*

Telnet (IP) Host Characteristics

Typically, the Telnet host is a PC with the appropriate suite of TCP/IP protocols, or a UNIX station.

The Telnet host can be directly connected to the managed FCD-E1LC unit, or be located at any site from which IP communication can be established to the managed FCD-E1LC.

Connection of Telnet Hosts

Telnet enables communication with multiple FCD-E1LC units, using either inband or out-of-band communication.

- For communicating out-of-band using the SLIP or PPP protocol, the Telnet host can be connected (or be able to communicate) to the control port of the FCD-E1LC unit.
- For inband communication, the user can enable the transfer of management traffic through the main and/or sublinks.

The Telnet protocol operates over IP. Since the IP traffic is automatically routed to the desired unit through the internal IP routers of chained equipment (see background information in *Appendix B* and *Appendix C),* a Telnet host capable of communicating with one FCD-E1LC unit may provide management access to several interconnected FCD-E1LC units, as well as to many other types of equipment that support this type of management (this includes many RAD network products, for example, Megaplex-2100, DXC multiservice access nodes, multiplexers, etc.).

Connections for SNMP Management

The SNMP protocol also operates over IP, therefore all the requirements described above for Telnet management also apply to the connection of SNMP network management stations.

Multidrop configurations must not be used with SNMP, because multidrop operation requires that all the units strictly observe the rules of polled communication. This is not true for SNMP agents, because they can initiate transmissions on their own (whenever they have a trap to transmit).

3.4 Turning Off the Unit

➤ To turn the FCD-E1LC off:

Disconnect the power from the FCD-E1LC.

Chapter 4

Configuration

This chapter provides configuration guidelines for configuring FCD-E1LC.

The configuration activities presented in this chapter require that the FCD-E1LC be first configured using a standard ASCII terminal, as explained in *Chapter 3*.

However, after performing the preliminary configuration of the terminal and the FCD-E1LC in accordance with *Chapter 3*, the same configuration activities can also be performed by means of a Telnet host, or an SNMP network management station.

For general information regarding the supervision language syntax, usage and commands, see *FCD-E1LC Command Language* below.

Detailed descriptions of each command appear in *Appendix D*.

4.1 Configuring for Management

The scope of the preliminary configuration activities is to enable management communication with the FCD-E1LC system.

See *Chapter 2* for detailed information on internal settings, and connection instructions.

Configuring the Supervision Terminal

The software necessary to run the FCD-E1LC control program is contained in the FCD-E1LC unit. To initialize FCD-E1LC for correct terminal operation, the control port parameters should be set as described in *Table 4-1*.

Table 4-1. Control Port Communication Parameters

Parameter	Settings for Terminal Management Session	Default
Speed	The FCD-E1LC control port can communicate at rates of 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200 bps. You can configure a specific rate, or enable the Autobaud function.	AUTO
Data Word	The word format consists of one start bit, 8 data bits, and one or two stop bits.	1 stop bit
Parity	Parity can be odd, even or none.	None
Interface	For direct connection, choose DCE. For connection through a modem or data link, choose DTE.	DCE

Before starting an initial configuration session, you must set the supervision terminal parameters to match the configuration of the CONTROL DCE port.

➤ To configure the supervision terminal:

1. Select full-duplex mode.
2. Turn the terminal echo off.
3. Disable any type of flow control.
4. Connect the terminal cable to the CONTROL DCE connector of FCD-E1LC.
5. Turn the supervisory terminal on.
6. For the initial configuration session, it is recommended to use the following communication parameters: 19200 bps (alternatively, since Autobaud is used as a default, you can also use any standard rate you prefer in the range of 1200 to 115200 bps), one start bit, eight data bits, no parity, one stop bit.
7. Turn terminal echo off, and disable any type of flow control.
8. Whenever feasible, configure the terminal to use VT-100 emulation.

You are now ready to start a supervision terminal configuration session.

Starting a Control Session

If the AUTO (Autobaud) mode is enabled, start the control session by pressing <Enter> three times.

After the FCD-E1LC has successfully identified the data rate of the supervision terminal, it displays the results of its power-up self-test:

```
FCD Self Test in Progress ... OK
```

or

```
FCD Self Test in Progress ... Failed
```

In the latter case, you must service the FCD-E1LC before you can continue using it. If FCD-E1LC successfully passed the power-up self-test, it sends the following message:

```
FCD Supervisory Port On Line. Type 'H' For Help
```

Note

- *When the node number of FCD-E1LC is a number other than zero, you must enter the node number before entering each command. Enter* NODE<SP>'node number'<SP>, *where* 'node number' *is the node number in the range from 1 to 255, and* <SP> *is a space. FCD-E1LC echoes the node number, i.e.* Node<SP>'node number'<SP>.
- *When password protection is enabled, FCD-E1LC displays the* PASSWORD> *prompt at the beginning of the session. In this case, type the current password (case-sensitive, four to eight characters). The default password is* `1234`*. If your password is accepted, the* `FCD>` *prompt is displayed.*

Preliminary Configuration

Perform the procedure explained below. If you need detailed instructions and explanations regarding each command, refer to *Appendix D*.

For detailed instructions regarding the use of the FCD-E1LC command line interface, refer to *Section 4.2*.

Load the Factory-Default Parameters

To load the default parameters, enter the **INIT DB** command.

Select the Supervisory Terminal Control Sequences

Select the terminal control sequences for the terminal type (or emulation) in use by entering the command **DEF TERM 'terminal_type'**. **'terminal_type'** stands for one of the following types: VT-52, VT-100, TV-920, FREEDOM100, FREEDOM220.

If your terminal requires control sequences differing from those used by the terminals listed above, type the command **F** and enter your terminal control sequences.

Configure the CONTROL DCE Port

Configure the CONTROL DCE port of the FCD-E1LC system by entering the command **DEF SP**. You will see the supervisory port configuration data form.

A typical form with the default values is shown below:

```
SPEED       STOP_BITS  PARITY   INTERFACE  CTS     DCD_DEL   DSR
AUTO        1          NONE     DCE         =RTS    0_MS      ON
POP_ALM  PWD  LOG_OFF  CALL_OUT_TRIGGER  ACTIVATE_CALL_OUT
AUXILIARY_DEVICE
NO       NO   NO       NONE              ANY CASE
TERMINAL
```

Set the Time and Date for the Internal Clock

Set the time of the internal clock of the FCD-E1LC system by entering the command **TIME**, and then set the date by entering the command **DATE**.

Note *The time and date must be set whenever the FCD-E1LC is powered up (either after a power failure or after being turned off).*

At this stage, you can start using the supervision terminal to perform FCD-E1LC configuration activities.

Activate Password Protection

To prevent unauthorized modification of the FCD-E1LC system parameters, you can use a password. The use of a password is controlled by the **DEF SP** command.

After enabling password protection, define the desired password by entering the command **DEF PWD**.

Configuring for Telnet or SNMP Management

Note *FCD-E1LC can be managed by Telnet or SNMP via inband management or over the control port using SLIP or PPP.*

To prepare the FCD-E1LC system for configuration by means of Telnet hosts and/or SNMP management stations, use the supervision terminal to configure the supervisory port and the SNMP agent as explained below.

Configure the SNMP Agent

- Define the FCD-E1LC system name, using the **DEF NAME** command.
- Define the FCD-E1LC SNMP agent parameters using the **DEF AGENT** command. The IP addresses of the SNMP agent and IP host must be within the same IP subnet, and the various community names must match those of the IP host. A typical SNMP agent parameters data form is shown below:

```
TELNET_APATHY_TIME            = 10 MIN

IP_ADDRESS                    = XXX.XXX.XXX.XXX

SNMP READ COMMUNITY           = public

SNMP WRITE COMMUNITY          = private

SNMP TRAP COMMUNITY           = public
```

where X stands for the digits of the prescribed IP address.

Configure the Inband Management

1. Type **DEF DNLOAD ML** to configure the FCD-E1LC inband management parameters for the main link or **DEF DNLOAD SL** to configure the sublink inband management parameters.
2. Define the desired management mode: TS0/F or Frame Relay.

   If you selected TS0/F, National Bits configuration screen appears:

```
DNLOAD MODE
TS0/F


SA_BIT_4  SA_BIT_5  SA_BIT_6  SA_BIT_7  SA_BIT_8
ZERO      ZERO      ZERO      ZERO      ZERO
```

   If you selected Frame Relay, the dedicated TS configuration screen appears:

```
DNLOAD MODE
FRAME_RL
TS_NUM     SPEED
30          64
```

3. Select the required parameters as described in *Appendix D* (**DEF DNLOAD ML** and **DEF DNLOAD SL** commands).

Configure the FCD-E1LC Control Port for Telnet and SNMP Access

To use the FCD-E1LC control port for Telnet and SNMP access, use the **DEF SP** commands, as applicable, and select the following parameters:

- Select the appropriate data rate in the **SPEED** field. Do not select **AUTO**.
- Select **NMS SLIP** or **NMS PPP** in the **AUXILIARY DEVICE** field.

Note *When using SLIP, if the FCD-E1LC control port is connected to a serial port of another RAD equipment unit, for example, a Megaplex-2100/2104, make sure to select* ***SLIP AGENT*** *in the* ***AUXILIARY DEVICE*** *field.*

At this stage, you can start using Telnet hosts or SNMP management stations to perform FCD-E1LC configuration activities.

Ending the Control Session

Type EXIT to end a supervision terminal session.

Type BYE to end a Telnet session.

4.2 FCD-E1LC Command Language

This section presents the FCD-E1LC command language, its syntax and command options, and an index of the supported commands.

Command Syntax

This section presents the supervision language syntax.

Enter commands at the FCD> prompt. This prompt appears at the beginning of each new line. The cursor appears to the right of the prompt.

If a node number is required, enter the node number before the command using the following syntax:

```
NODE<SP>‘node number’<SP>‘command’<Enter>.
```

FCD-E1LC echoes commands as you enter them, character by character.

Use <Space> as a separator between command fields and/or parameters.

To correct typing errors, press <Backspace> until the error is cleared, then enter the correct characters.

To execute a command, press <Enter>. After when the command is executed, FCD-E1LC displays the current date and time, and then displays a new command prompt.

After the last page of the data form, press <Enter> to initiate command evaluation.

To cancel command execution, press <Ctrl+C>; the FCD> prompt appears, and you can enter a new command.

Note *You can also use <Ctrl+C> to stop the automatic repetition of commands sent with the /R option.*

You can recall and edit previous commands by pressing <Ctrl+A>. FCD-E1LC stores the last 10 commands in a special buffer, and each <Ctrl+A> pressing retrieves the previous command from that buffer. The retrieved command appears on the command line, and can be edited as desired.

Press <Ctrl+D> to execute again the last command.

If an idle disconnect time-out is specified, FCD-E1LC automatically disconnects the ongoing session if no command is received from the terminal for the specified time-out interval.

If you enter an invalid command, FCD-E1LC does not execute it and displays the following:

- If the command is not valid in the current system configuration, or the values you are trying to set are incorrect, FCD-E1LC displays an appropriate error message. For a list of configuration error messages, refer to *Configuration Error Messages* in *Chapter 4*.
- If the command syntax is incorrect, FCD-E1LC displays the following message:

```
Bad command or parameter. Type 'h' for help
```

In this case you must enter the correct command.

If the terminal screen fills up during the exchange with the FCD-E1LC, it displays the following message:

```
HIT SPACE-BAR TO CONTINUE
```

After pressing the spacebar, the terminal scrolls to the next page.

What to Do If …

If FCD-E1LC does not respond to any command entered at the terminal, this may be caused by one of the following:

- FCD-E1LC is configured to use a protected password: to correct, select first the factory-default password.
- CONTROL DCE communication parameters are not identical to those of the terminal: to correct, select first the factory-default parameters.

Selecting the Factory-Default Password

The FCD-E1LC is delivered with password protection disabled. If the password protection has been enabled (using the DEF SP command), you must enter a password when you start a control session. If the password is incorrect, the FCD-E1LC will not respond. However, even if the current password is not known, you can establish management communication with the FCD-E1LC by appropriate setting of the PSW section of SW2, located on the FCD-E1LC main board. Set the PSW section of SW2 as follows:

OFF In this position, you can define your own password and node address.

ON Set the section to ON to restore the default FCD-E1LC password (1234), and change the node address to the default value of 0. The change will be made after you turn the FCD-E1LC off for a short time, and then back on. After restoring the default values, return the switch section to OFF. If the section is left at ON, your changes will be discarded (i.e., replaced again by the default values) the next time the FCD-E1LC is turned on.

Selecting the Factory-Default Supervisory Port Communication Parameters

If the supervisory port parameters are not correct, the FCD-E1LC will not respond. This can be corrected by means of the DEF PAR section of the switch SW2. Set the DEF PAR section of the DIP switch as follows:

OFF In this position, you can define the desired supervisory port parameters.

ON Set the switch section to ON to enforce the default supervisory port parameters. The default parameters are AUTO (automatically detected data rate), one start bit, eight data bits, no parity, one stop bit and no flow control.

With the switch section at ON, the default parameters values override the values in the configuration database.

The database values can only be changed using the DEF SP command. Therefore, after setting the switch to ON, establish communication with the FCD-E1LC using the default parameters values and configure the desired values.

When ready to use the new values, return the switch section to OFF, and then change the communication parameters of the terminal as required.

Ending a Control Session

You can end the control session in one of the following three ways:

- Disconnect the cable from the FCD-E1LC front-panel CONTROL DCE connector.
- Send the EXIT command from the supervisory terminal (for Telnet sessions, use BYE).
- FCD-E1LC automatically disconnects the ongoing session if no commands are received for a certain period of time (controlled by the LOG_OFF parameter). You can, however, disable this timeout. For Telnet sessions, the disconnect interval is determined by the Telnet apathy time.

After the session is ended, it is necessary to enter the correct password again to start a new session (if the password was enabled).

Note *A control session may also be terminated by the FCD-E1LC when the terminal DTR line switches to the inactive (OFF) state.*

Command Options

Table 4-2 lists general types of options, which are available with some commands. See details in the explicit command set index, *Table 4-3.*

Table 4-2. Command Options

Option	Meaning	Example of Usage
/A	All	CLR ALM /A Clears all the alarms stored by the alarm buffer
/C	Clear	DSP BERT /C Display BERT results and clear the BER counter
/CA	Clear all	DSP PM /CA Display the performance monitoring counters, and then clear (reset to 0) all the counters
/I	Start the injection of errors	DSP BERT ML /I
/R	Repeat automatically command execution. Available only when node address is 0; not available with Telnet	DSP BERT ML /R Enables you to monitor the updated results of the bit error rate test being run on the FCD-E1LC
/S	Stop the injection of errors	DSP BERT ML /S

Index of Commands

Table 4-3 lists the FCD-E1LC command set in alphabetical order.

Table 4-3. FCD-E1LC Command Set Index

Command	Purpose	Options
BYE	End the current Telnet session	
CLR ALM	Clear alarms stored in the FCD-E1LC alarm buffer	/A
CLR LP LOC ANA ML CLR LP LOC ANA SL CLR LP LOC DIG ML CLR LP LOC DIG SL CLR LP REM ANA ML CLR LP REM ANA SL CLR LP REM DIG ML CLR LP REM DIG SL CLR LP LOC CH 1 CLR LP LOC CH 2 CLR LP REM CH 1 CLR LP REM CH 2 CLR LP ML CLR LP SL CLR LP CH 1 CLR LP CH 2	Clear the corresponding user-initiated test or loopback.	

Command	Purpose	Options
CLR LOOP LOC ANA ML CLR LOOP LOC ANA SL CLR LOOP LOC DIG ML CLR LOOP LOC DIG SL CLR LOOP REM ANA ML CLR LOOP REM ANA SL CLR LOOP REM DIG ML CLR LOOP REM DIG SL CLR LOOP LOC CH 1 CLR LOOP LOC CH 2 CLR LOOP REM CH 1 CLR LOOP REM CH 2 CLR LOOP ML CLR LOOP SL CLR LOOP CH 1 CLR LOOP CH 2 CLR LOOP BERT ML CLR LOOP INBAND ML	Clear user-initiated test or loopback.	
DATE	Set the date for the FCD-E1LC internal clock	
DEF AGENT	Define the FCD-E1LC SNMP agent configuration parameters	
DEF ALM MASK	Define the alarms to be masked (ignored)	
DEF AR	Define the alarm reporting method, and the alarm indications, for each alarm level	
DEF BERT ML	Define the type of test sequence to be used for BER testing on the main link	
DEF CALL	Define the dial-out parameters	
DEF CH	Configure the parameters of the data channel	
DEF DNLOAD ML	Define the main link inband management parameters	
DEF DNLOAD SL	Define the sublink inband management parameters	
DEF MANAGER LIST	Define or modify the network management stations to which the SNMP agent of this FCD-E1LC unit will send traps	
DEF ML	Configure main link parameters	
DEF NAME	Define the logical name of the FCD-E1LC	
DEF NODE	Define the node number of the FCD-E1LC	
DEF PROMPT	Define the supervisory port prompt	
DEF PWD	Define a new password	
DEF ROUTE	Define the network management stations to be statically routed via the supervisory port	
DEF SL	Configure sublink parameters	
DEF SP	Configure supervisory port parameters	
DEF SYS	Configure system parameters	
DEF TERM	Reset the terminal control codes to 0	

Command	Purpose	Options
DEF TERM VT100 DEF TERM TV920 DEF TERM VT52 DEF TERM FREEDOM100 DEF TERM FREEDOM220	Select the control codes for one of the standard terminal types	
DSP AGENT	Display the SNMP agent parameters	
DSP ALM	Display the contents of the alarm buffer and optionally clear the buffer	/C /CA
DSP BERT ML	Display the results of the last BER measurement made on the main link	/I /R /S /C
DSP HDR TST	Displays hardware test results	
DSP MANAGER LIST	Display the network management stations to which the SNMP agent of this FCD-E1LC unit sends traps	
DSP PM ML	Display the contents of the main link performance monitoring registers, and optionally clear these registers	/C /CA
DSP PM SL	Display the contents of the sublink performance monitoring registers, and optionally clear these registers	/C /CA
DSP REM AGENT	Display information on the remote SNMP agents handled by the FCD-E1LC IP router	
DSP ST CH1 DSP ST CH2	Display status information on a data channel	
DSP ST ML	Display status information on the main link	/C
DSP ST SL	Display status information on the sublink	/C
DSP ST SYS	Display system status	
DSP TS	Display information on the use and type of main link timeslots	
EXIT	End the current control session	
F	Define control codes for the supervision terminal	
HELP	Displays a concise index of commands and option switches	
INIT DB	Load the default configuration instead of the user's configuration	
LOOP LOC ANA ML LOOP LOC ANA SL LOOP LOC DIG ML LOOP LOC DIG SL LOOP REM ANA ML LOOP REM ANA SL LOOP REM DIG ML LOOP REM DIG SL LOOP LOC CH 1 LOOP LOC CH 2 LOOP REM CH 1 LOOP REM CH 2 LOOP BERT ML LOOP INBAND ML	Activate the corresponding user-controlled test or loopback.	
RESET	Reset the FCD-E1LC	
TIME	Set the time of the FCD-E1LC internal clock	

Chapter 5

Configuring FCD-E1LC for a Typical Application

This chapter provides configuration guidelines for FCD-E1LC systems.

The configuration activities presented in this chapter require that the FCD-E1LC be first configured using a standard ASCII terminal, as explained in *Chapter 3*.

However, after performing the preliminary configuration of the terminal and the FCD-E1LC in accordance with *Chapter 4*, the same configuration activities can also be performed by means of a Telnet host, or an SNMP network management station.

For general information regarding the supervision language syntax, usage and commands, refer to *Chapter 4.*

Detailed descriptions of each command appear in *Appendix D*.

5.1 Typical Configuration Procedures

Outline of General Configuration Procedure

To prepare a typical FCD-E1LC system for operation in accordance with customer's requirements, perform the following activities in the order given in *Table 5-1*.

Table 5-1. Outline of Configuration Procedures

Step	Activity	Reference
	Perform the preliminary configuration	*Chapter 3*
	Define system configuration	DEF SYS
	Configure the FCD-E1LC main link	DEF ML
	Configure each FCD-E1LC port and its connections to the main link	DEF SL DEF CH1 DEF CH2
	Define the general system parameters	DEF AGENT DEF MANAGER LIST DEF ROUTE DEF NAME DEF PROMPT DEF PWD
	Define dial-up parameters (when applicable)	DEF CALL
	Define alarm handling parameters	DEF ALM MASK DEF AP DEF AR

5.2 Configuration Example

This section illustrates the procedure details for configuring two FCD-E1LC units using a supervision terminal, for a typical application (see *Figure 5-1*).

In this application, two FCD-E1LC units, each having one data channel and a sub link, are interconnected via the E1 network and managed by a RADview network management station attached to a DXC unit. The data channel rate is 128 kbps, the number of voice channels to be connected between the two PBXs is 10, and the management station is connected to both FCD-E1LC units via the main links.

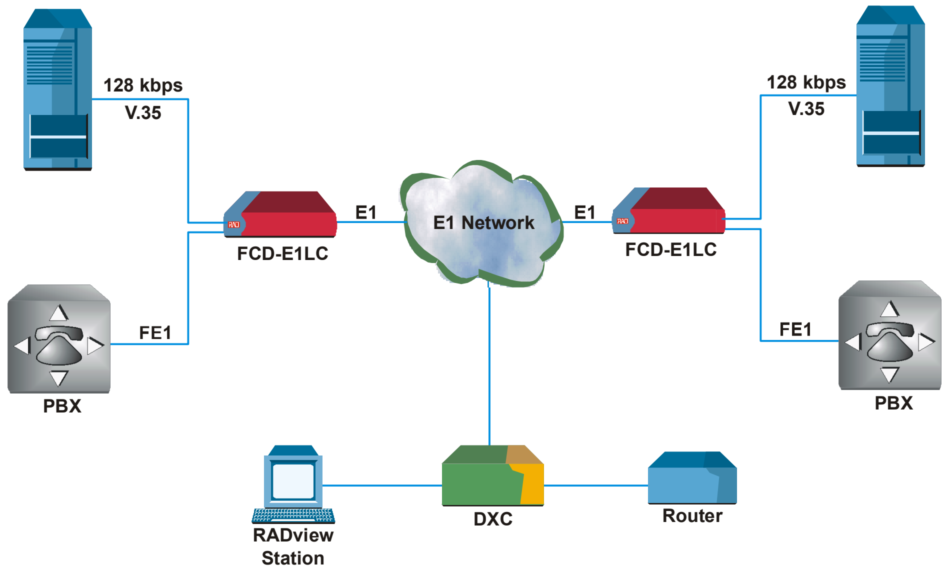


Figure 5-1. FCD-E1LC Application for Configuration Examples Interconnected by an E1 Network

Configuring the Local FCD-E1LC

Configure General System Parameters

1. Type **INIT DB** to reset the FCD-E1LC database to the default parameters.
2. Type **DEF TERM VT-100** to configure the control port to operate with the terminal control codes of the VT-100 terminal.
3. Type **DEF SP** to configure the control port.

   A typical display, as seen after the required parameters have been selected, is shown below:

```
SPEED     STOP_BITS     PARITY     INTERFACE     CTS     DCD_DEL
DSR
AUTO      8             NO         DCE           =RTS    0 MS
ON
POP_ALM    PWD    LOG_OFF   CALL_OUT_TRIGER   ACTIVATE_CALL_OUT
AUXILIARY_DEVICE
NO         NO     NO        NONE              ANY CASE
TERMINAL
```

4. Type **DEF MANAGERS LIST** to configure the FCD-E1LC to accept one RADview management station:
   - The RADview station IP address is 192.114.029.201
   - The total number of managed units is 16, therefore the subnet mask is 255.255.255.240.

   A typical data form, as seen after the rows used to define the first management station have been filled in, is shown below:

```
MANAGER 1 IP ADDRESS       192.114.029.201
MANAGER 1 SUBNET MASK      255.255.255.240
```

5. Type **DEF AGENT** to configure the SNMP agent parameters:
   - The FCD-E1LC management IP address is 192.114.029.209
   - Write community used by the RADview station: RAD
   - The other parameters can be left at their factory defaults.

   A typical display, as seen after the required parameters have been selected, is shown below:

```
OLD AGENT PARAMETERS
- - - - - - - - - - - - - - -
IP_ADDRESS IS             :   = 0.0.0.0

READ COMMUNITY IS         :   = public

WRITE COMMUNITY IS        :   = private

TRAP COMMUNITY IS         :   = public


TELNET_APATHY_TIME

10 MIN

IP_ADDRESS IS             :   = 192.114.029.209

READ COMMUNITY IS         :   = public

WRITE COMMUNITY IS        :   = RAD

TRAP COMMUNITY IS         :   = public
```

6. Type **DEF DNLOAD ML** to configure the FCD-E1LC inband management parameters for the main link:
   - Management mode: Frame Relay
   - Network management traffic carried in timeslot 30.

   A typical display, as seen after the required parameters have been selected, is shown below:

```
DNLOAD MODE
FRAME_RL
TS_NUM     SPEED
30          64
```

Configure Main Link Parameters

Type **DEF ML** to define the required main link parameters:

- E1 link interface operating mode: LONG
- Framing mode: G.732N

- Enable the CRC-4 function (YES)
- Set the idle timeslot code to 7F
- Enable transparent reporting of sub link alarms through the main link (RAI = ENABLE).

After configuration, you should see the following display:

```
FRAME    CRC-4    SYNC     RX_GAIN   IDLE_TS_CODE    RAI

G732N    YES      CCITT    LONG      3F              ENABLE
```

Configure Sub Link Parameters

Type **DEF SL** to define the required sub link parameters:

- E1 link interface operating mode: SHORT
- Framing mode: G.732S
- Enable the CRC-4 function (YES)
- Set the idle timeslot code to 7F
- Enable transparent reporting of sub link alarms through the main link (RAI = ENABLE)
- Use the out-of-service code 3F
- Transfer 10 subscriber timeslots and the signaling timeslot (timeslot 16) through the main link.

After configuration, you should see the following display:

```
FRAME       CRC-4      SYNC      RX_GAIN     IDLE_TS_CODE        RAI
G732N       NO         CCITT     SHORT       7F                  ENABLE
CGA         OOS_SIG    OOS_CODE
NONE         N/A       3F
MAP_MODE  START_TS  TS_TYPE  NUM_OF_TS
USER      N/A       N/A      N/A
TS   :   1      2      3      4      5      6       7      8
TYPE :   DATA   DATA   NO     NO     NO     NO      VOICE  VOICE
TS   :   9      10     11     12     13     14      15     16
TYPE :   VOICE  VOICE  VOICE  VOICE  VOIC   VOICE   VOICE  DATA
TS   :   17     18     19     20     21     22      23     24
TYPE :   VOICE  NO     NO     NO     NO     NO      NO     NO
TS   :   25     26     27     28     29     30      31
TYPE :   NO     NO     NO     NO     NO     DEDIC   NO
```

Configure Data Channel Parameters

Type **DEF CH 1** to define the data channel characteristics and connect it to the main link timeslots 1 and 2.

After configuration, you should see the following display:

MULTIPLIER	SPEED	FIFO_SIZE	CLOCK MODE	CTS	CLOCK_POLARITY
64	128	AUTO	DCE	ON	NORMAL

MAP_MODE	START_TS	TS_TYPE
SEQ	1	DATA

TS :	1	2	3	4	5	6	7	8
TYPE :	DATA	DATA	NO	NO	NO	NO	NO	NO
TS :	9	10	11	12	13	14	15	16
TYPE :	NO	NO	NO	NO	NO	NO	NO	NO
TS :	17	18	19	20	21	22	23	24
TYPE :	NO	NO	NO	NO	NO	NO	NO	NO
TS :	25	26	27	28	29	30	31	
TYPE :	NO	NO	NO	NO	NO	DEDIC	NO	

Check Main Link Timeslot Assignment

Type **DSP TS** to check main link timeslot assignment.

The resulting display is shown:

TS :	01	02	03	04	05	06	07	08	09	10	
TYPE :	DATA	DATA	NC	NC	NC	NC	VOICE	VOICE	VOICE	VOICE	
DEST :	CH1	CH1	NA	NA	NA	NA	SUB	SUB	SUB	SUB	
TS :	11	12	13	14	15	16	17	18	19	20	
TYPE :	VOICE	VOICE	VOICE	VOICE	VOICE	DATA	VOICE	NC	NC	NC	
DEST :	SUB	SUB	SUB	SUB	SUB	SUB	SUB	NA	NA	NA	
TS :	21	22	23	24	25	26	27	28	29	30	31
TYPE :	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
DEST :	NA	NA	NA	NA	NA	NA	NA	NA	NA	DEDIC	NA

Configure System Timing

Type **DEF SYS** to configure the FCD-E1LC nodal timing:

- Lock FCD-E1LC timing to the recovered main link clock
- Use the internal oscillator as fallback source.

After configuration, you should see the following display:

CLK_MASTER	CLK_FBACK	DATE_FORMAT
ML	NONE	DD-MM-YYYY

Configuring the Remote FCD-E1LC

Repeat the procedure for the other FCD-E1LC.

Chapter 6

Troubleshooting and Diagnostics

This chapter describes the FCD-E1LC diagnostic functions. The diagnostic functions available on the FCD-E1LC include:

- Alarm and event collection – see *Section 6.3*
- Collection of performance monitoring data – see *Section 6.1.*
- Test and loopbacks for checking transmission paths – see *Section 6.4*.

These functions can be used to identify problems in the network incorporating FCD-E1LC units, test the proper operation of each FCD-E1LC unit, and rapidly locate the cause of the fault: within the FCD-E1LC itself, in its connections to the network or to a user's equipment unit, or in another network component.

In addition to the information listed above, you can find in *Section 6.4* troubleshooting instructions, including a list of the configuration ("sanity") error messages generated by the FCD-E1LC. This Section will help you solve problems that prevent normal operation of the equipment.

If you need additional support for this product, see *Section 6.6* for technical support information.

6.1 Monitoring Performance

The FCD-E1LC enables collecting transmission performance data for its main and sublinks. The collected data enables the system administrator to monitor the transmission performance, and thus the quality of service provided to users, for statistical purposes.

In addition, when problems are reported by users served by FCD-E1LC, the collected data can be used for diagnostic purposes, because it can help identify the source of the problem.

This section describes the FCD-E1LC performance evaluation and monitoring functions. the available performance monitoring parameters depend on the configuration of the main and sublink:

- When the CRC-4 option is enabled, it is possible to monitor end-to-end the data transmission performance. The error detection information is derived from the data payload, by performing a cyclic redundancy check (CRC). The resulting CRC checksum is transmitted in addition to the raw data bits. The receiving end recalculates the checksum and compares the results with the

received checksum: any difference between the two checksums indicates that one or more bit errors are contained in the current data block being evaluated.

- When the CRC-4 option is disabled, most of parameters available with the CRC-4 option enabled are available as well, but the line transmission impairments are detected in a different way (based on bipolar coding violations).

The main link performance data can be displayed by means of the DSP PM ML command, and the sublink data – by means of the DSP PM SL command, as explained in *Appendix D*. The performance monitoring parameters are listed in *Table* 6-1.

By adding the /CA switch to the command, you can reset all the performance diagnostics registers.

Table 6-1. Performance Monitoring Parameters

Display	Name	Description
CURRENT ES	Current errored seconds	CRC-4 enabled: An errored second is any second containing one or more of the following events: CRC error events, OOF events, AIS events, controlled slip events. CRC-4 disabled: An errored second is any second containing one or more BPV events, or one or more OOF events, or one or more AIS events, or one or more controlled slip events. In both cases, the data is collected for the current 15-minute interval.
CURRENT UAS	Current unavailable seconds	An unavailable second is any second in which a failed signal state exists. A failed signal state is declared when 10 consecutive severely errored seconds (SES) occur, and is cleared after 10 consecutive seconds of data are processed without a SES.
CURRENT SES	Current severely errored seconds	CRC-4 enabled: A SES is a second with 832 or more CRC error events, or one or more OOF events. CRC-4 disabled: A SES is a second with 2048 or more BPV events. In both cases, the data is collected for the current 15-minute interval.
CURRENT BES	Current bursty errored seconds	CRC-4 enabled: A BES is a second with 2 to 319 CRC error events and no AIS events. The data is collected for the current 15-minute interval. CRC-4 disabled: not relevant.
CURRENT LOFC	Current loss of frame counter	The loss of frame (LOF) counter counts the loss of frame alignment events. The data is collected for the current 15-minute interval.
CURRENT LES	Current line errored seconds	A line errored second is a second in which one or more Line Code Violation events were detected. The data is collected for the current 15-minute interval.

Display	Name	Description
CURRENT SEFS	Current severely errored framing seconds	A severely errored framing second is a second with 320 or more OOF events or one or more AIS event. The data is collected for the current 15-minute interval.
CURRENT DM	Current degraded minutes	The total number of degraded minutes in the current 15-minute interval. A degraded minute is a minute in which the BPV events rate ranges between 1×10^{-3} and 1×10^{-6}. This number is updated every minute.
CURRENT CSS	Current slip second counter	A CSS is a second with one or more controlled slip events. The data is collected for the current 15-minute interval.
CURRENT TIMER	Current interval timer	Seconds elapsed from the start of interval counting.
24 HOUR ES	Long-term errored seconds	The total number of ES in the current 24-hour interval.
24 HOUR UAS	Long-term fail seconds	The total number of UAS in the current 24-hour interval.
24 HOUR SES	Long-term severely errored seconds	The total number of SES in the current 24-hour interval.
24 HOUR BES	Long-term bursty errored seconds	The total number of BES in the current 24-hour interval.
24 HOUR LES	Long-term line errored seconds	The total number of LES in the current 24-hour interval.
24 HOUR SEFS	Long-term severely errored framing seconds	The total number of SEFS in the current 24-hour interval.
24 HOUR LOFC	Long-term loss of frame counter	The total number of LOF events in the current 24-hour interval.
24 HOUR LES	Long-term line errored seconds	The total number of LES in the current 24-hour interval.
24 HOUR SEFS	Long-term severely errored framing seconds	The total number of SEFS in the current 24-hour interval.
24 HOUR LOFC	Long-term loss of frame counter	The total number of LOF events in the current 24-hour interval.
24 HOUR CSS	Long-term slip second counter	The total number of CSS in the current 24-hour interval.
24 DEGRADE MIN	Long-term degraded minutes	The total number of degraded minutes in the last 24-hour interval. This number is updated every minute.
LAST 24 DEGRADE MIN	Last degraded minutes	The total number of degraded minutes in the previous 24-hour interval. This number is updated every 24 hours.
24 INTERVAL	Long-term interval counter	The number of valid 15-minute intervals in the previous 24-hour period.

Display	Name	Description
BPV LAST MINUTE	Last-minute BPV counter	The number of BPV events detected in the last minute.
BPV WORST MINUTE	Worst-minute BPV counter	The number of BPV events detected during the worst minute since the last time the counters were cleared.

6.2 Detecting Errors

Power-Up Self-Test

Upon power-up, FCD-E1LC automatically performs self-test, to test critical circuit functions. At the start of the self-test procedure, the front panel indicators are turned on and then off: during this interval, check that all the indicators are *OK*.

- If a problem is detected during self-test, FCD-E1LC automatically sends reports to the supervision terminal.
- If the self-test is successfully completed, FCD-E1LC starts normal operation, and its front-panel indicators display the status, as explained in *Chapter 2*.

6.3 Handling Alarms

After starting normal operation, the FCD-E1LC continuously monitors critical signals and signal processing functions. In case a problem is detected, the FCD-E1LC generates time-stamped alarm messages that cover all the events. An internal real-time clock provides the time stamp.

Note *The internal clock does not have battery backup, and therefore must be set to the correct time after turn-off or power failure. This action can be performed by the management station, or by means of the supervision terminal.*

For continuous system monitoring, the user can enable automatic transmission of alarm messages through the supervisory port. Alarm messages are also automatically sent as traps to the user-specified network management stations.

Internally, the FCD-E1LC stores alarms in an alarm buffer. This alarm buffer can store up to 100 alarm messages, together with their time stamps. The alarm history buffer is organized as a FIFO queue; therefore after 100 alarms are written into the buffer, new alarms overwrite the oldest alarms.

The alarms can be read on-line by the network administrator using the network management station, a Telnet host, or a supervision terminal. The network administrator can then use the various diagnostic tests to determine the causes of the alarm messages and to return the system to normal operation.

Alarm Display

FCD-E1LC displays alarm messages on the supervision terminal. There are two types of alarms, designated as ON/OFF and ON:

- An ON/OFF alarm is a state alarm: it is displayed only when the alarm condition is present, and is automatically removed when the condition is cleared (if the alarm is being displayed, it will disappear only when the display is refreshed by scrolling).
- An ON alarm is an event alarm: it records the occurrence of event and therefore it persists even after the event that caused the alarm condition is cleared.

When an ON/OFF-type alarm changes its state from ON to OFF, it is not removed from the alarm buffer. The state change is indicated by a new message, which added to the alarm buffer.

➤ To display the alarm history:

- Type **DSP ALM**.

The terminal displays the alarms stored in the buffer (up to 100), listing for each alarm its number, the alarm message, its state (ON or OFF), and the time and date when the last change in its state occurred. A typical display looks like this:

```
ALARM 21   SIGNAL LOSS       ON     01:42:11     2001-01-01
ALARM 25   LOCAL SYNC LOSS   ON     01:45:14     2001-01-01
```

➤ To clear the alarm buffer:

- Type **CLR ALM /CA**.

Alarm Messages

Table 6-2 presents the alarm messages displayed on the FCD-E1LC control terminal in ascending order of their numbers, and lists the actions required to correct the alarm condition.

Table 6-2. FCD-E1LC Alarm Messages

Alarm Number	Terminal Message	Description	Corrective Actions	Severity	Type
04	**ALARM BUFFER OVERFLOW**	More than 100 alarms entries have been written in the alarm buffer since the last clear command	Read the messages, and then send the CLR ALM /A (CA) command from the supervision terminal	MINOR	ON
06	**DB-INIT SWITCH IS ON**	The INIT_DB section of switch SW2 is set to ON (the changes made to the database will be lost if the unit is turned off or reset)	1. Remove FCD-E1LC cover. 2. Set the section to OFF.	MINOR	ON
07	**CLOCK WAS CHANGED TO FALLBACK**	The FCD-E1LC switched to the fallback clock source, because the master clock source failed	Check the master clock source. A clock source is replaced as a result of failure under the following conditions: 1. ML or SL – fails during local loss of frame synchronization on the main link 2. CH1 or CH2 – fails when the data channel equipment is disconnected or inoperative (DTR line not asserted)	MINOR	ON
08	**CLOCK WAS CHANGED TO INTERNAL**	The FCD-E1LC switched to the internal clock source, because both the master and the fallback clock sources failed	1. Check the two clock sources. 2. Perform the power-up self-test and replace the FCD-E1LC if a failure is detected	MINOR	ON
09	**CLOCK WAS CHANGED TO MASTER**	The FCD-E1LC switched back to the clock source selected as the master source	Normal state – no action required	MINOR	ON
10	**DIAL-OUT CYCLE FAILED**	The current cycle of call attempts failed	Check the modem connected to the CONTROL DCE connector. If the called numbers are often busy, you may also increase the number of call retries	MAJOR	ON

Table 6-2. FCD-E1LC Alarm Messages (Cont.)

Alarm Number	Terminal Message	Description	Corrective Actions	Severity	Type
11	**DATABASE CHECKSUM ERROR**	FCD-E1LC technical failure (the database currently stored in the non-volatile memory of FCD-E1LC is corrupted)	1. Use the supervision terminal to enter the INIT DB command. 2. Turn the FCD-E1LC off for a few minutes, and then turn it back on and read the alarm messages generated during the power-up self-test. Replace the FCD-E1LC if a failure is detected	MAJOR	ON/OFF
12	**PSWRD SWITCH IS ON**	PWD section of switch SW2 is set to ON	If it is no longer necessary to enforce the default password and node number, return the switch section to OFF	MINOR	ON
13	**SP-PAR SWITCH IS ON**	Section DEF PAR of switch SW2 is set to ON	If this setting is no longer required, return the switch section to OFF.	MINOR	ON
15	**DIAL-OUT PRIMARY CALL FAILED**	The call attempts to the primary dial-out number failed	If the number is not busy, check the modem connected to the CONTROL DCE connector. If the called number is often busy, you may also increase the number of call retries	MAJOR	ON
16	**DIAL-OUT ALTERNATE CALL FAILED**	The call attempts to the alternate dial-out number failed	If the number is not busy, check the modem connected to the CONTROL DCE connector. If the called number is often busy, you may also increase the number of call retries	MAJOR	ON
17	**SELF TEST ERROR**	A problem has been detected during FCD-E1LC self-test	Replace the FCD-E1LC.	MAJOR	ON/OFF
21	**SIGNAL LOSS**	Loss of main link port receive signal	1. Check cable connections to the link connector. 2. Check line and/or other communication equipment providing the link to the remote unit. 3. Perform the power-up self-test and replace the FCD-E1LC if a failure is detected.	MAJOR	ON/OFF
22	**EXCESSIVE BPV**	The rate of bipolar violations in the main link receive signal exceeds 1×10^{-6} during a measurement interval of 1000 seconds	1. Problem in the network facilities used by the main link. 2. Turn the FCD-E1LC off for a few minutes, and then turn it back on and read the alarm messages generated during the power-up self-test. Replace the FCD-E1LC if a failure is detected	MAJOR	ON/OFF

Table 6-2. FCD-E1LC Alarm Messages (Cont.)

Alarm Number	Terminal Message	Description	Corrective Actions	Severity	Type
23	**AIS OCCURRED**	AIS is being detected on the link	Problem at the equipment connected to the remote end of the link	MAJOR	ON/OFF
24	**AIS SYNC LOSS**	Local loss of frame synchronization alarm on the main link, caused by AIS condition	Problem at the equipment connected to the remote end of the link	MAJOR	ON/OFF
25	**LOCAL SYNC LOSS**	Local loss of frame synchronization alarm on the main link	1. Check cable connections to the link connector. 2. Check line and/or other communication equipment providing the link to the remote FCD-E1LC 3. Replace the FCD-E1LC	MAJOR	ON/OFF
26	**LOCAL MF ALARM**	Local loss of multiframe synchronization alarm on the main link	1. Check that the correct framing mode is used at the local and remote ends. 2. Perform the corrective actions listed for LOCAL SYNC LOSS.	MAJOR	ON/OFF
27	**REMOTE MF ALARM**	Remote loss of multiframe synchronization alarm on the main link	Problem at the remote equipment.	MAJOR	ON/OFF
28	**REMOTE SYNC LOSS**	Remote loss of frame synchronization alarm on the main link	Problem at the remote equipment. Perform the following checks on the remote equipment: 1. Check cable connections to the link connector. 2. Check line and/or other communication equipment providing the link to the remote equipment. 3. Replace the equipment.	MAJOR	ON/OFF
29	**FRAME SLIP**	Frame slips are detected on the main link. Updated once per second. *Note*:This alarm message is not displayed during local loss of frame synchronization	1. Incorrect selection of master clock source 2. Problem at far end (unstable clock source) 3. Replace the FCD-E1LC only if steps 1 and 2 do not correct the problem.	MAJOR	ON

Table 6-2. FCD-E1LC Alarm Messages (Cont.)

Alarm Number	Terminal Message	Description	Corrective Actions	Severity	Type
30	**BPV ERROR**	Bipolar violations in the main link receive signal. Updated once per second	Have the main link checked. Perform the power-up self-test and replace the FCD-E1LC if a failure is detected	MINOR	ON
31	**EXCESSIVE ERR RATIO**	The bit error rate of the link receive signal exceeds 1×10^{-3}	1. Problem in the network facilities used by the main link. 2. Turn the FCD-E1LC off for a few minutes, and then turn it back on and read the alarm messages generated during the power-up self-test. Replace the FCD-E1LC if a failure is detected	MAJOR	ON/OFF
32	**CRC-4 ERROR**	CRC-4 errors detected in the main link receive signal. Updated once per second	1. Have the link checked. 2. Perform the power-up self-test and replace the FCD-E1LC if a failure is detected	MINOR	ON
34	**SFIFO SLIP**	Technical problem (FIFO overflow/underflow), usually caused by differences in clock rates	1. Check the clock mode of the corresponding data channel. 2. Turn the FCD-E1LC off for a few minutes, and then turn it back on and read the alarm messages generated during the power-up self-test. Replace the FCD-E1LC if a failure is detected.	MAJOR	ON
35	**LOOP INBAND ON**	An inband activated loopback is now connected on the data channel	If the loopback is no longer needed, disconnect it	MAJOR	ON
36	**MANAGEMENT PORT IS LOOPED**	The management port receives its own messages (this could be caused by a test loopback on the communication path used for SNMP management or on the management port). Management is not possible while this condition is present	Find the location of the loopback and request disconnection	MAJOR	ON/OFF

Table 6-2. FCD-E1LC Alarm Messages (Cont.)

Alarm Number	Terminal Message	Description	Corrective Actions	Severity	Type
37	**MANAGEMENT PORT IS DOWN**	The FCD-E1LC cannot communicate with the network management station. This may indicate incorrect setup of the management port parameters, a problem on the communication path, or a hardware failure	1. Correct the parameters. 2. Check for disconnection. 3. Check for hardware failure. 4. Check the management communication path	MAJOR	ON/OFF
38	**DUPLICATE NAME IN THE NETWORK**	Another node in the network uses the FCD-E1LC logical name. This prevents SNMP management	Check and change as required	MAJOR	ON/OFF
42	**LINK INTEGRITY ERROR**	The Ethernet interface is not connected to an operating LAN	Check the cable connecting the LAN, the LAN media, and check that at least one station is active on the LAN	MAJOR	ON/OFF
43	**RTS/CONTROL IS OFF**	Indicates that the RTS signal on the DTE unit is off.	Set the RTS signal on the DTE unit to ON state.	MAJOR	ON/OFF
60	**CRC MF ALARM**	Local loss of synchronization to the CRC-4 multiframe on the main link (only on E1 port operating with CRC-4 enabled)	1. Check cable connections to the port connector. 2. Check line and/or other communication equipment providing the link to the remote unit. 3. Replace the FCD-E1LC unit.	MINOR	ON

6.4 Troubleshooting

Preliminary Checks

If the problem is detected the first time the FCD-E1LC is put into operation, perform the following preliminary checks before proceeding:

- Check for proper installation and correct cable connections, in accordance with the system installation plan.
- Check the configuration parameters in accordance with the specific application requirements, as provided by the system administrator. In particular, check for configuration error messages (see the *Configuration Error Messages* section below).
- If the FCD-E1LC nodal clock is to be locked to the clock recovered from one of the user ports, make sure a suitable fallback clock source is configured and provides a good clock signal.

Configuration Error Messages

If FCD-E1LC detects a configuration mismatch, it displays an appropriate configuration error message on the supervision terminal.

The configuration error messages have the format ERROR, followed by a numeric code and a short error message after the error code. *Table* 6-3 lists the configuration error messages in ascending order of their codes and explains each of them.

Table 6-3. FCD-E1LC Configuration Error Messages

Error Code	Terminal Message and Description
ERROR 000	MASTER AND FALLBACK CLOCK ARE THE SAME You are trying to select the same source as both master and fallback clock source. Check and change as required.
ERROR 001	INVALID MASTER CLOCK SOURCE The channel you are trying to select as the master clock source is either not connected, or its clock mode is not DTE2. Check and change as required.
ERROR 002	INVALID FALLBACK CLOCK SOURCE The channel you are trying to select as the fallback clock source is either not connected, or its clock mode is not DTE2 Check and change as required.
ERROR 003	ILLEGAL DCD DELAY AND INTERFACE COMBINATION You are trying to select a non-zero DCD DELAY after the FCD-E1LC supervisory port interface has been set as DCE.

Error Code	Terminal Message and Description
ERROR 004	CONFLICT IN INTERFACE AND DSR PARAMETERS You selected DSR=ON after the supervisory port interface has been set to DTE. The DSR=ON selection is valid only for DCE interface.
ERROR 005	TIMESLOT 16 OF E1-G732S FRAME IS MAPPED You are trying to select the G732S framing mode while timeslot 16 is assigned to one of the data channels or dedicated to inband management. Free timeslot 16 before selecting the G732S framing.
ERROR 006	CONFLICT BEETWEEN FRAME AND TIME SLOT TYPES The port uses G732N framing, but the specified timeslot is configured as a voice timeslot. Change the type to data.
ERROR 007	CHANNEL SPEED NOT MATCH OPEN NUMBER OF TS The number of timeslots currently allocated to the data channel is not equal to the number of timeslots required to support the nominal data rate configured. Either increase the number of timeslots, or reduce the channel data rate.
ERROR 008	FCD IN LOOP CAN'T UPDATE HARDWARE When a test or loopback is active, it is not possible to change the FCD-E1LC operating mode in accordance with the updated configuration parameters. You may see this message either after pressing ENTER, or after a update data base command has been received through the supervisory port (or inband management). You must first deactivate the test or loopback.
ERROR 009	CONFLICT BETWEEN CLOCK MODE AND FIFO SIZE You are trying to select the DCE or DTE1 clock mode when the FIFO size is not AUTO. A specific FIFO size can be selected only for the DTE2 mode. Select AUTO.
ERROR 010	TIME-SLOT OUT OF RANGE When using the SEQ or ALT mapping mode, the sum of the number of timeslots requested for the data channel and the number of starting timeslot exceeds 31. Check and change as required.
ERROR 011	ILLEGAL TIMESLOT ALLOCATION The specified timeslot is allocated to more than one user. Check and correct timeslot allocation.
ERROR 012	ILLEGAL UNFRAMED CONFIGURATION You cannot configure the unframed mode when there are main link timeslots connected to ports.
ERROR 013	ILLEGAL SPEED FOR AUXILIARY DEVICE The AUTO (Autobaud) mode cannot be selected when the supervisory port is to support the SLIP protocol (AUX DEV parameter is set to SLIP-NMS).
ERROR 014	WRONG IP ADDRESS The syntax of the IP address is incorrect. The IP address must be entered in the dotted-quad format (four numbers in the range of 0 through 255, separated by periods), as explained in *Appendix B*.

Error Code	Terminal Message and Description
ERROR 015	WRONG SUB NET ADDRESS Wrong IP address subnet mask syntax (the same syntax as common IP).
ERROR 016	TWO OR MORE MANAGERS WITH SAME IP ADDRESS Check that each network management station has a different IP address.
ERROR 017	DEDICATE TIME-SLOT IS MAPPED The timeslot you are trying to select for use as the dedicated inband management timeslot on the main link is already assigned. Check and change as required.
ERROR 018	ILLEGAL DOWNLOAD CONFIGURATION You are trying to enable downloading while using the UNFRAME mode. When using the UNFRAME mode, you must disable downloading.
WARNING 019	CONFLICT BETWEEN SYSTEM CLK AND CHANNEL CLK A data channel is configured to use the clock mode DTE2, but the master clock source is not configured to use that channel. Check and change as required.
ERROR 020	DEDICATE TIME-SLOT IS NOT MAPPED The protocol selected for inband management requires the use of dedicated timeslot, but no timeslot has been assigned to management on the main link.
ERROR 021	FIFO SIZE TOO SMALL When selecting the FIFO size manually, you can select only a size which exceeds the default FIFO size for the corresponding rate. Increase the FIFO size.
ERROR 022	PORT TYPE AND DTE2 CONFLICT RS-232 and X.21 interfaces do not support the DTE2 clocking mode.
ERROR 023	CHANNEL SPEED EXCEEDS INTERFACE LIMIT A channel with RS-232 interface needs a maximum of 2 timeslots, because its data rate can not exceed 128 kbps.
ERROR 051	ILLEGAL PORT LOOP COMBINATION You are trying to activate an illegal loopback combination (see *Allowed Loopback Combinations* on page *6-24*). First deactivate the loopback that is currently active.
ERROR 052	LOOP IS NOT ACTIVE You are trying to deactivate a loopback or test that is not active. Check and change as required.
ERROR 053	CURRENT LOOP ALREADY BEING PERFORMED You are trying to activate a loopback that is already active. Check and change as required.
ERROR 054	ILLEGAL PARAMETER FOR CURRENT CONFIGURATION You are trying to configure a parameter which is not supported by this FCD-E1LC version.
ERROR 055	LOOP NOT SUPPORTED ON CURRENT FCD TYPE You are trying to activate a loop that is not supported by the FCD-E1LC.

Error Code	Terminal Message and Description
ERROR 056	ILLEGAL COMMAND FOR CURRENT PORT MODE You are trying to activate a command that cannot be activated due to current port mode. Check and change as required.
ERROR 057	REPETITIVE MODE CAN'T BE PERFORMED THROUGH TELNET You are trying to use a command with /R option while using Telnet for management. This is not allowed.
ERROR 058	CANT PERFORM LOOP - CHANNEL NOT CONNECTED You are trying to activate a loopback on the data channel while it is not connected.
ERROR 059	ILLEGAL FIELD VALUE The value entered in the specified field is not allowed. Check and correct as required.
WARNING 060	NEW ROUTE ADDRESS WILL BE ACTIVE ONLY AFTER RESET After changing the agent route address, you should reset the unit in order for the system to store the change.
ERROR 061	NEW DOWNLOAD MODE WILL BE ACTIVE ONLY AFTER RESET To bring into effect the change of the downloading parameter, you have to restart FCD-E1LC.
ERROR 062	ILLEGAL COMMAND FOR CURRENT PORT The parameter you are trying to configure is not supported by this port (e.g., you can not configure BERT parameters for the E1 sublink).

Troubleshooting Procedure

If the preliminary checks do not correct the problem, check the displayed alarm messages and perform the corrective actions described in *Table* 6-2.

If the problem cannot be corrected by performing the actions listed in *Table* 6-2, use *Table* 6-4: identify the trouble symptoms and then perform the actions listed under *Corrective Measures* in the order given in the table, until the problem is corrected.

Table 6-4. Troubleshooting Chart

Trouble Symptoms	Probable Cause	Corrective Measures
FCD-E1LC is "dead"	1. No power	Check that both ends of the power cable are connected properly.
	2. Defective FCD-E1LC	Replace the FCD-E1LC.
Local FCD-E1LC reports local main link sync loss	1. External problem	Activate the local analog loopback on the main link. Check that the local FCD-E1LC MAIN LOC SYNC LOSS indicator turns OFF. If the indicator is OFF, the problem is external.

Trouble Symptoms	Probable Cause	Corrective Measures
	2. Defective FCD-E1LC	Turn the FCD-E1LC off for a few minutes, and then turn it back on and read the alarm messages generated during the power-up self-test. Replace the FCD-E1LC if a failure is detected.
Local FCD-E1LC reports local sublink sync loss	1. External problem	Activate the remote analog loopback on the sublink. Check that the local FCD-E1LC SUB LOC SYNC LOSS indicator turns OFF. If the indicator is OFF, the problem is external.
	2. Defective FCD-E1LC	Turn the FCD-E1LC off for a few minutes, and then turn it back on and read the alarm messages generated during the power-up self-test. Replace the FCD-E1LC if a failure is detected.
Local user connected to the FCD-E1LC data channel cannot communicate with the remote equipment (main link operates normally)	1. External problem	Activate the local loopback on the data channel. Check that the equipment connected to the channel receives its own signal. If not, the problem is external.
	2. Defective FCD-E1LC	Turn the FCD-E1LC off for a few minutes, and then turn it back on and read the alarm messages generated during the power-up self-test. Replace the FCD-E1LC if a failure is detected.
LINK indicator of Ethernet port is not lit	1. No active station on the LAN	Check that at least one station is active on the LAN
	2. Cable problem	Check and replace if necessary the cable that connects the FCD-E1LC 10/100BASE-T connector to the LAN
	3. Problem on the LAN	Check LAN media
	4. Defective FCD-E1LC	Turn the FCD-E1LC off for a few minutes, and then turn it back on and read the alarm messages generated during the power-up self-test. Replace the FCD-E1LC if a failure is detected

6.5 Testing the Unit

The diagnostic loopbacks and tests are used to identify rapidly and efficiently the location of a problem that prevents normal service.

A diagnostic loopback is activated by entering the appropriate LOOP (or LP) command, and is deactivated using the CLR LOOP (or CLR LP) command. This section provides a general description of each loopback and test.

Before executing a test, pay attention to the following:

- If a loopback is already connected, the TST indicator lights.
- If you try to connect a loopback while another loopback of the same type is already connected, FCD-E1LC displays an error message.
- Not all of the loopback combinations are allowed.

  For the list of allowed loopback combinations, refer to *Allowed Loopback Combinations* on page *6-24*.
- No loopbacks are available for the Ethernet interface. In addition, main link loopbacks should not be activated on an FCD-E1LC with Ethernet interface while the Ethernet interface is connected to the LAN. This would cause a state of permanent collision on the LAN, which would prevent other users from using the LAN as long as the loopback is connected.

Overview of Test and Loopbacks

The FCD-E1LC supports the following types of test and loopback functions:

- Main link:
  - Main link local analog loopback (LP LOC ANA ML)
  - Main link remote analog loopback (LP REM ANA ML)
  - Main link local digital loopback (LP LOC DIG ML)
  - Main link remote digital loopback (LP REM DIG ML)
  - Inband-activated loopback (LP INBAND ML) on the main link
  - BER testing (LP BERT ML)
- Sublink:
  - Sublink local analog loopback (LP LOC ANA SL)
  - Sublink remote analog loopback (LP REM ANA SL)
  - Sublink local digital loopback (LP LOC DIG SL)
  - Sublink remote digital loopback (LP REM DIG SL)
- Data channel:
  - Data channel local loopback (LP LOC CH)
  - Data channel remote loopback (LP REM CH).

The test and loopback functions are described in the following sections. The test functions are identified by the command used to activate the corresponding test/loopback function. For clarity, the figures used to illustrate the signal paths while a loopback or test is activated show only two user ports: one data channel and the (optional) sublink.

Main Link Tests and Loopbacks

Main Link Local Analog Loopback (LP LOC ANA ML)

This loopback is performed by connecting the main link transmit signal to the input of the receive path within the LIU section of the main link interface, as shown in *Figure* 6-1.

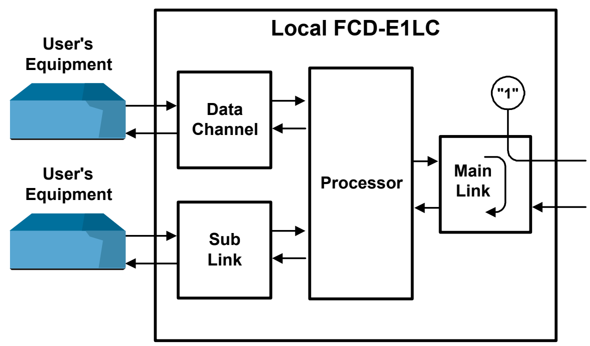


Figure 6-1. Main Link Local Analog Loopback

The test signal is provided by the equipment connected to the local user ports: each one must receive its own transmission.

Note *Before activating this loopback on an FCD-E1LC with Ethernet interface, disconnect the LAN cable from the rear panel Ethernet interface.*

During the loopback, the local FCD-E1LC sends an unframed “all-ones” signal to the remote FCD-E1LC.

This test fully checks the local FCD-E1LC operation and the connections to the local user’s equipment.

Main Link Remote Analog Loopback (LP REM ANA ML)

The main link remote analog loopback is a locally performed analog loopback towards the remote equipment. The loopback connects, at the local FCD-E1LC, the regenerated receive signal to the transmit input of the main link interface within the LIU section of the main link interface, as shown in *Figure* 6-2.

The test signal is provided by the user's equipment connected to the ports of the remote FCD-E1LC: each one must receive its own transmission.

This test checks the connections to the remote user’s equipment, all the circuits of the remote FCD-E1LC, the main link interface functions of the remote and local FCD-E1LC, and the transmission plant connecting the two FCD-E1LC.

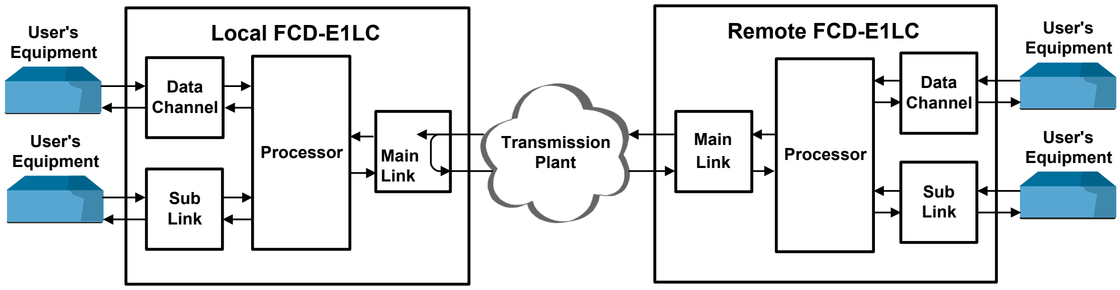


Figure 6-2. Main Link Remote Analog Loopback

Main Link Local Digital Loopback (LP LOC DIG ML)

This main link local digital loopback is performed by connecting the E1 digital transmit signal of the main link to the input of the receive path, without passing through the main link line interface (LIU). Signal paths are shown in *Figure* 6-3.

Note *Before activating this loopback on an FCD-E1LC with Ethernet interface, disconnect the LAN cable from the rear panel Ethernet interface.*

The test signal is provided by the equipment connected to the local user ports: each one must receive its own transmission.

During the loopback, the local FCD-E1LC sends an unframed "all-ones" signal to the remote FCD-E1LC.

This test checks the digital circuits of the local FCD-E1LC (processor section), and the connections to the local user's equipment.

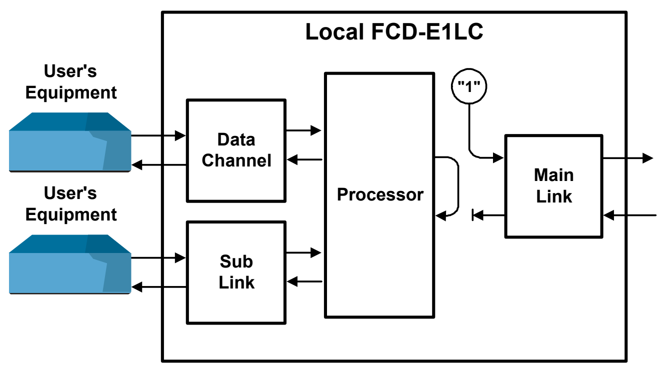


Figure 6-3. Main Link Local Digital Loopback

Main Link Remote Digital Loopback (LP REM DIG ML)

The main link remote digital loopback is a locally performed digital loopback towards the remote equipment. The loopback connects, at the local FCD-E1LC, the regenerated receive signal to the transmit input of the main link interface within the framer section of the main link interface, as shown in *Figure* 6-4.

The test signal is provided by the user's equipment connected to the user ports of the remote FCD-E1LC: each one must receive its own transmission.

This test checks the connections to the remote user's equipment, all the circuits of the remote FCD-E1LC, the main link interface functions of the remote and local FCD-E1LC, and the transmission plant connecting the two FCD-E1LC.

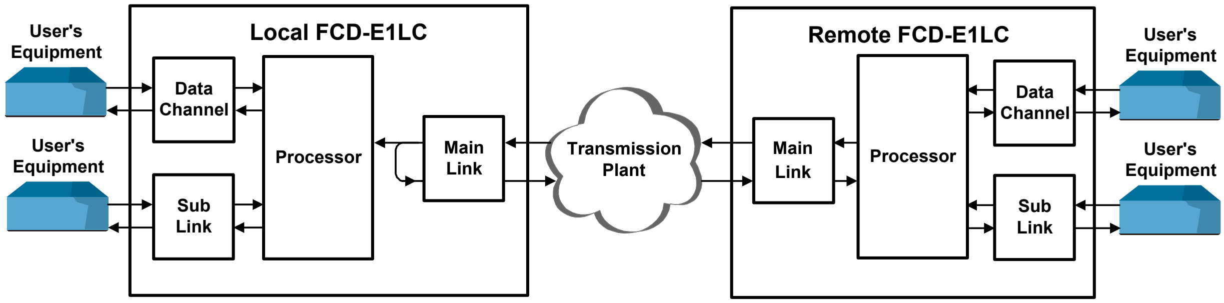


Figure 6-4. Main Link Remote Digital Loopback

Inband-Activated Loopback (LP INBAND ML)

FCD-E1LC supports the inband-activated loopback function, which includes:

- Transmission of special loopback activation/deactivation codes to the remote equipment, in user-specified timeslots of the main link interface
- Detection of inband-loopback activation/deactivation codes. The detection of the activation code in certain main link timeslots results in the activation of the loopback in the corresponding timeslots, and the deactivation code cancels the loopback.

Note *To enable the activation of a loopback in response to the reception of the inband loopback activation code from a remote unit, use the DEF BERT ML command to set the RX_INBAND parameter to ENABLE, and then configure the same test timeslots and activation/deactivation patterns on both units.*

Figure 6-5 shows the signal paths related to the inband-activated loopback, when the loopback is activated on the local FCD-E1LC in response to a command received from the remote equipment (another FCD-E1LC or other equipment supporting the inband-activated loopback).

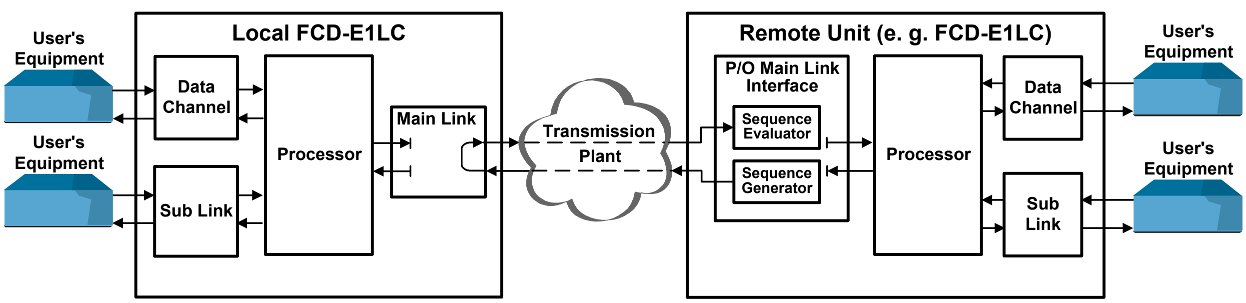


Figure 6-5. Inband-Activated Loopback

The loopback activated in this way is similar to the main link remote digital loopback, except that it is performed on the local FCD-E1LC, in response to a command entered at the remote FCD-E1LC, and only in selected timeslots .

The FCD-E1LC allows the user to specify the desired timeslots in which the activation/deactivation sequences are sent, or instruct the FCD-E1LC to activate the loopback in the timeslots assigned to the desired user port (data channel 1

or 2, or the sublink). If you already specified timeslots for BER testing (by means of the DEF BERT ML command), the FCD-E1LC will automatically use the timeslots specified for BER testing, if such definition is present

The loopback is activated and deactivated by transmitting special sequences for approximately 2 seconds:

- The FCD-E1LC sending the sequence reports this state as TX INBAND
- The FCD-E1LC receiving the sequence reports this state as RX INBAND.

You can use the standard FT1/FE1 RDL inband sequence specified in ANSI (T1.403), or select a pattern of your own.

- With the INBAND_LOOP_PATTERN is set to RDL, when the LP INBAND ML command is activated, the generator sends the standard RDL sequence.
- With the INBAND_LOOP_PATTERN is set to USER, you can specify a desired string, consisting of 1 to 8 bits. The generator then repetitively sends this string.

After the loopback is activated in response to the detection of the appropriate sequence, the local FCD-E1LC starts returning the activation sequence toward the activating unit, where it is detected by the sequence evaluator. This confirms the activation of the requested loopback.

To deactivate the loopback (in response to a CLR LP INBAND ML command), the generator sends the corresponding loop deactivation sequence (either RDL or the user-configured string). The deactivation is confirmed when the reception of the deactivation sequence stops.

BER Testing (LP BERT ML)

The BER test subsystem comprises a test sequence generator and a test sequence evaluator (the same circuits used by the inband-activated loopback function, which were described above). During the test, the main link payload data is replaced by a pseudo-random sequence generated by the test sequence generator. The transmitted data is returned to the test sequence evaluator by a loopback activated somewhere along the main link signal path.

The evaluator synchronizes to the incoming sequence, and then compares the received data, bit by bit, to the original data sequence and detects any difference (bit error). The test results are presented on the supervision terminal (see the *DSP BERT ML* command in *Appendix D*).

To calibrate the system, the user can inject errors at a selectable rate.

When two FCD-E1LC units are operated in a link, it is also possible to perform the test by activating the BER test subsystems at both ends of the link at the same time and configuring both subsystems to use the same test parameters. In this case, it is not necessary to activate a loopback, because the BER test subsystem can process the sequence transmitted by the far end subsystem in the same way as its own sequence. This avoids the need to activate a loopback when the loopback itself may alter the operating conditions on the tested path (for example, in certain cases a loopback may cause switching to an alternate clock source and thus affect the flow of timing information within the network).

The BER test is used for two purposes:

- As part of the tests that check the operation of the local FCD-E1LC. For this purpose, activate one of the local main link loopbacks, or connect a physical loopback that returns the main link transmit data through the receive path at a desired location along the signal path.
- Check the quality of transmission over the whole link (end-to-end): in this case, you may use the inband-activated loopback to create the loopback and then activate the BER test. Alternately, you can activate the BER test at both ends of the link, as explained above, or, if the remote equipment does not support the BER test function, you can also use standard BER test equipment.

The type of test sequence and the timeslots in which the test is performed can be selected by the user (see the *DEF BERT ML* command in *Appendix D*).

During the test, the local user's equipment is disconnected.

Sublink Loopbacks

Sublink Local Analog Loopback (LP LOC ANA SL)

The sublink local analog loopback is performed by connecting the sublink transmit signal to the input of the sub receive path within the LIU section of the sublink interface, as shown in *Figure* 6-6.

The test signal is provided by the equipment connected to the local sublink, that must receive its own transmission. This test fully checks the connections to the equipment connected to the local sublink, and the analog (LIU) section of the sublink interface.

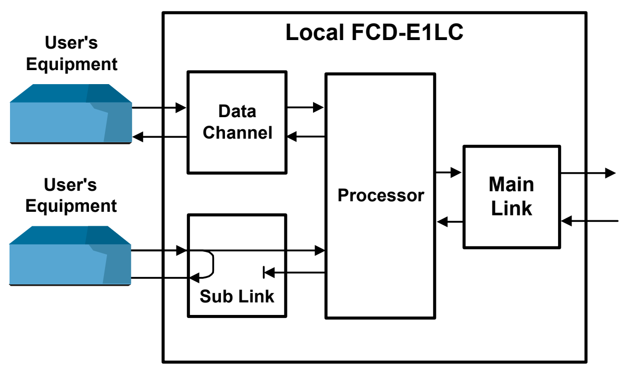


Figure 6-6. Sublink Local Analog Loopback

Sublink Remote Analog Loopback (LP REM ANA SL)

The sublink remote analog loopback is performed by connecting the sublink transmit signal to the input of the sub receive path within the LIU section of the sublink interface, as shown in *Figure* 6-7. The test signal is provided by the equipment connected to the remote sublink, which must receive its own transmission.

During the loopback, the local FCD-E1LC sends an unframed "all-ones" signal to the equipment connected to the local sublink port.

This test checks the connections to the equipment connected to the remote sublink port, all the circuits of the remote FCD-E1LC, the functions of the remote and local FCD-E1LC, and the transmission plant interconnecting the two FCD-E1LC.

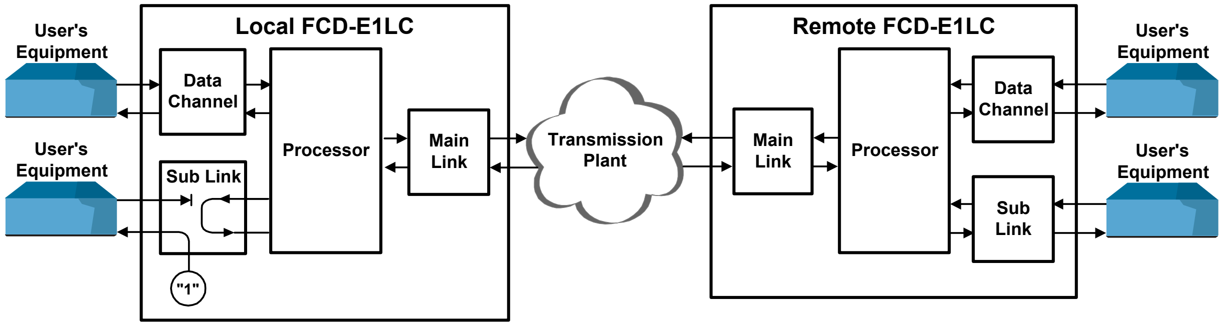


Figure 6-7. Sublink Remote Analog Loopback

Sublink Local Digital Loopback (LP LOC DIG SL)

The sublink local digital loopback is performed by connecting the sublink transmit signal to the input of the sub receive path within the LIU section of the sublink interface, as shown in *Figure* 6-8.

The test signal is provided by the equipment connected to the local sublink, which must receive its own transmission. This test fully checks the connections to the equipment connected to the local sublink, including the operation of the sublink interface.

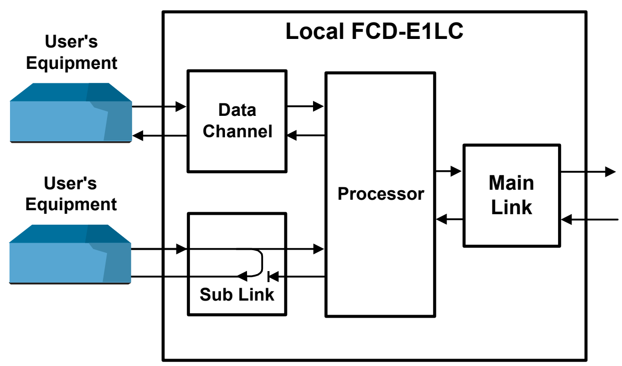


Figure 6-8. Sublink Local Digital Loopback

Sublink Remote Digital Loopback (LP REM DIG SL)

The sublink remote digital loopback is performed by connecting the sublink transmit signal to the input of the sub receive path within the framer section of the sublink interface, as shown in *Figure* 6-9. The test signal is provided by the equipment connected to the remote sublink, which must receive its own transmission.

This test checks the same functions as the sublink remote analog loopback, except that it does not check the operation of the analog sublink interface.

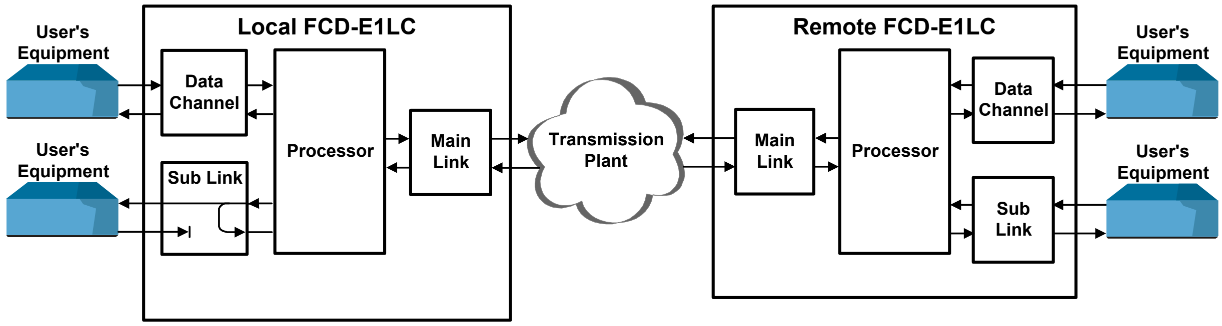


Figure 6-9. Sublink Remote Digital Loopback

Data Channel Loopbacks

Data Channel Local Loopback (LP LOC CH 1, LP LOC CH 2)

The data channel local digital loopback is performed towards the user's equipment connected to the selected local data channel (channel 1 or channel 2). The loopback is performed by connecting the data channel transmit signal to the input of the receive path as shown in *Figure* 6-10.

The test signal is provided by the local user's equipment, which must receive its own transmission. This test checks the connections to the local user's equipment and the data channel interface.

Note *When an alarm condition is present on the main link, the receive data is held at MARK. Under these conditions, it is not possible to perform BER measurements when a local channel loopback is connected. If you try to measure BER, the result is invariably errors.*

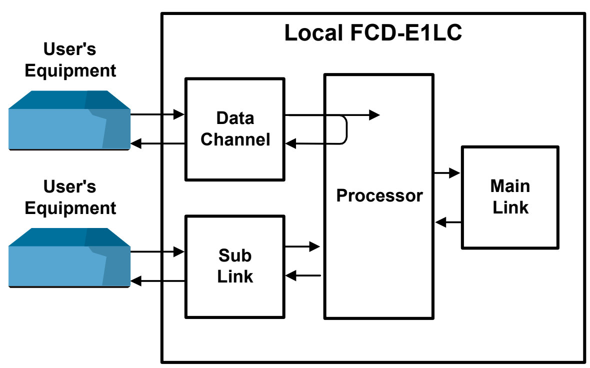


Figure 6-10. Data Channel Local Loopback

Data Channel Remote Loopback (LP REM CH 1, LP REM CH 2)

The data channel remote loopback is performed towards the user's equipment connected to the selected data channel of the remote FCD-E1LC. The loopback is performed by connecting the local data channel receive signal to the data channel transmit input without passing through the local data channel interface, as shown in *Figure 6-11*. The test signal is provided by the remote user's equipment, which must receive its own transmission.

This test checks end-to-end the data link, including the cables connecting the remote user's equipment to the FCD-E1LC, the remote FCD-E1LC, the transmission plant connecting the two FCD-E1LC, and the local FCD-E1LC (except for the data channel interface).

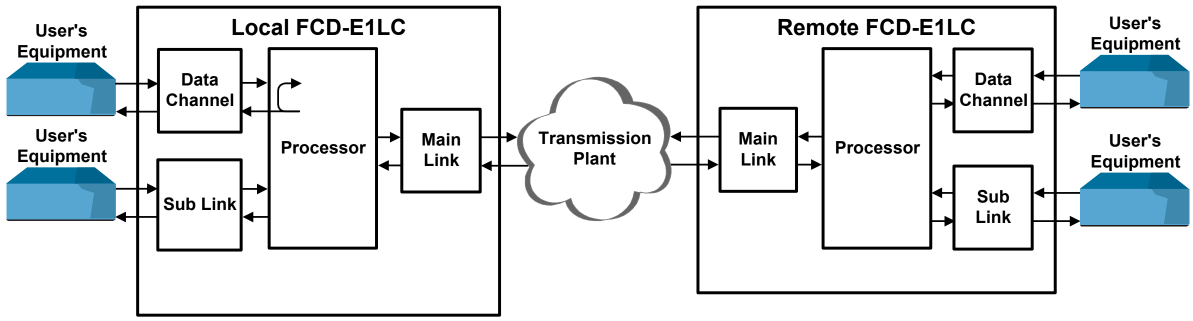


Figure 6-11. Data Channel Remote Loopback

Allowed Loopback Combinations

Not all of the loopback combinations are allowed, because some loopbacks disconnect the signal paths of other loopbacks. If you try to activate an illegal loop combination, FCD-E1LC sends a configuration error (ERROR 051: ILLEGAL PORT LOOP COMBINATION).

For example:

- It is not possible to activate simultaneously remote (including inband-activated) and local analog loopbacks on the main link because that would disconnect the signal source for the local loopback.
- It is not possible to activate any remote data channel or sublink loopback when any main link loopback (analog or digital, local, remote or inband-activated) is activated
- It is not possible to simultaneously activate local and remote loopbacks on the same data channel.

The following types of loopbacks can however be simultaneously activated:

- Main link: remote analog loopback and local digital loopback, and inband-loopback activation together with BER testing
- Sublink: remote digital loopback and local analog loopback
- You can simultaneously activate loopbacks of any type on different data channels, or a data channel and the sublink.

To help you decide when you are not sure whether you can activate an additional loopback while one is already activated, you can find in the following tables (*Table* 6-5 to *Table* 6-12) systematic lists of allowed (Yes) and not allowed (No) loopbacks for each combination of ports. Active indicates the already activated loopback.

Note

It is not possible to activate loopbacks on the Ethernet port. You can only activate inband loopbacks and test the BER in the main link timeslots assigned to the Ethernet port, to check transmission quality for the Ethernet payload.

Table 6-5. Main Link Loopback Combinations

Additional Main Link Loopback	Active Main Link Loopback						
	Local Analog	Local Digital	Remote Analog	Remote Digital	BERT	TX Inband	RX Inband
Local Analog	No	No	No	No	Yes	No	No
Local Digital	No	No	Yes	No	Yes	No	No
Remote Analog	No	Yes	No	No	No	No	No
Remote Digital	No	No	No	No	No	No	No
BERT	Yes	Yes	No	No	No	Yes	No
TX Inband Code Transmission	No	No	No	No	Yes	No	No
RX Inband Code Detection	No	No	No	No	No	No	No

Table 6-6. Sublink Loopback Combinations

Additional Sublink Loopback	Active Sublink Loopback			
	Local Analog	Local Digital	Remote Analog	Remote Digital
Local Analog	No	No	No	Yes
Local Digital	No	No	No	No
Remote Analog	No	No	No	No
Remote Digital	Yes	No	No	No

Table 6-7. Main Link and Sublink Loopback Combinations

Additional Sublink Loopback	Active Main Link Loopback						
	Local Analog	Local Digital	Remote Analog	Remote Digital	BERT	TX Inband	RX Inband
Local Analog	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Local Digital	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Remote Analog	No	No	No	No	No	No	No
Remote Digital	No	No	No	No	No	No	No

Table 6-8. Sublink and Main Link Loopback Combinations

Additional Main Link Loopback	Active Sublink Loopback			
	Local Analog	Local Digital	Remote Analog	Remote Digital
Local Analog	Yes	Yes	No	No
Local Digital	Yes	Yes	No	No
Remote Analog	Yes	Yes	No	No
Remote Digital	Yes	Yes	No	No
BERT	Yes	Yes	No	No
TX Inband Code Transmission	Yes	Yes	No	No
RX Inband Code Detection	Yes	Yes	No	No

Table 6-9. Data Channel Loopback Combinations

Data Channel 1 Additional Loopback	Data Channel 1 Active Loopback		Data Channel 1 Additional Loopback	Data Channel 2 Active Loopback	
	Local	Remote		Local	Remote
Local	No	No	Local	Yes	Yes
Remote	No	No	Remote	Yes	Yes
Data Channel 2 Additional Loopback	**Data Channel 1 Active Loopback**		**Data Channel 2 Additional Loopback**	**Data Channel 2 Active Loopback**	
	Local	Remote		Local	Remote
Local	Yes	Yes	Local	No	No
Remote	Yes	Yes	Remote	No	No

Table 6-10. Main Link and Data Channel Loopback Combinations

Data Channel 1 and/or 2 Additional Loopback	Active Main Link Loopback						
	Local Analog	Local Digital	Remote Analog	Remote Digital	BERT	TX Inband	RX Inband
Local	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Remote	No	No	No	No	No	No	No

Table 6-11. Data Channel and Main Link Loopback Combinations

Additional Main Link Loopback	Data Channel 1 and/or 2 Active Loopback	
	Local	Remote
Local Analog	Yes	No
Local Digital	Yes	No
Remote Analog	Yes	No
Remote Digital	Yes	No
BERT	Yes	No
TX Inband Code Transmission	Yes	No
RX Inband Code Detection	Yes	No

Table 6-12. Data Channel and Sublink Loopback Combinations

Additional Sublink Loopback	Data Channel 1 and/or 2 Active Loopback	
	Local	Remote
Local Analog	Yes	Yes
Local Digital	Yes	Yes
Remote Analog	Yes	Yes
Remote Digital	Yes	Yes

6.6 Frequently Asked Questions

Question: How do I configure Unframed mode in FCD-E1LC?

Answer: For transmission of unframed data, select UNFRM for the main link.
For a single-channel FCD-E1LC, the data rate of channel 1 is automatically set to 2048 kbps.
For a two-channel FCD-E1LC, the data rate of channel 2 is automatically set to 2048 kbps.

```
FCD>def ml

FRAME CRC-4 SYNC RX_GAIN IDLE_TS_CODE RAI
UNFRM NO CCITT SHORT 3F DISABLE
```

Question: Does FCD-E1LC support both balanced and unbalanced options for the uplink?

Answer: Yes, the FCD-E1LC supports both balanced and unbalanced options.
Note that you should use an adapter cable when working in unbalanced mode (Cable name: CBL-RJ45/2BNC/E1/X).

Question: Can FCD-E1's IR-ETH interface work opposite FCD-E1LC's IR-ETH/V interface?

Answer: Yes.
The ETQN for 10/100BaseT Ethernet bridge with VLAN support of the FCD-E1LC can work opposite ETUQ for UTP (10BaseT) Ethernet bridge with VLAN support of the FCD-E1.

Question: Is it possible to manage MAP products supporting dedicated Frame Relay for inband management using a Cisco Router?

Answer: Yes, it is possible.
Please note that Cisco must be configured as follows:
DLCI= 100
NO LMI
MTU = 200

Following is an example configuration:
Controller E1 0/0
Channel-group 0 timeslots 31
Interface Serial0/0:0
MTU 200
Bandwidth 64
IP address 17.17.17.2 255.255.255.0
Encapsulation frame-relay IETF
No keepalive
Frame-relay map IP 17.17.17.10 100 broadcast
Interface FastEthernet 0/0
IP address 10.10.10.2 255.255.255.0
No IP split-horizon
Duplex auto

Speed auto
No cdp enable

Please note that if you start the Cisco unit from with default parameters, you have to "open" the Ethernet interface:
Router(config)#inter fast 0/0
Router(config-if)#no shutdown
Router(config-if)#
Router(config-if)#end

6.7 Technical Support

Technical support for this product can be obtained from the local distributor from whom it was purchased.

For further information, please contact the RAD distributor nearest you or one of RAD's offices worldwide. This information can be found at www.rad.com (offices – About RAD > Worldwide Offices; distributors – Where to Buy > End Users).

Appendix A

Connection Data

A.1 Main Link Connection Data

Connector Data

The main link port is terminated in an eight-pin RJ-45 connector, designated E1/T1 MAIN. *Table A-1* lists the pin assignment of the connector, and *Figure A-1* identifies the connector pins.

Table A-1. Main Link Connector, Pin Assignment

Pin	Function
1	Receive data input (ring)
2	Receive data input (tip)
3	Not connected
4	Transmit data output (ring)
5	Transmit data output (tip)
6	Not connected
7	Sense pin for detecting the connection of the unbalanced interface adapter cable
8	Ground

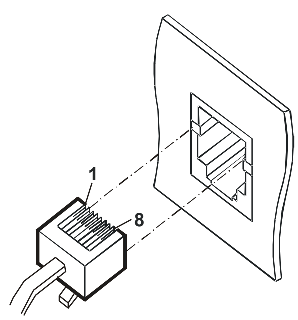


Figure A-1. Main Link RJ-45 Connector, Pin Identification

Connection Cable for Balanced Interface

The cable used for connecting the FCD-E1LC main link to equipment with balanced E1 interface should include only two twisted pairs, one for the transmit path and the other for the receive path.

The cable end intended for connection to the FCD-E1LC must be terminated in an RJ-45 plug. Make sure pin 7 in the RJ-45 plug is not connected: the main link port will switch to the unbalanced interface if DC current can flow from pin 7 of the FCD-E1LC E1/T1 MAIN connector to ground.

Connection Cable for Unbalanced Interface, CBL-RJ45/2BNC/E1/X

To connect the FCD-E1LC main link to equipment with unbalanced E1 interface, it is necessary to convert the FCD-E1LC RJ-45 connector to the standard pair of BNC female connectors used for unbalanced E1 interfaces.

For this purpose, RAD offers a 15-cm long adapter cable, CBL-RJ45/2BNC/E1/X, which has one RJ-45 plug for connection to FCD-E1LC E1/T1 MAIN connector and two BNC female connectors at the other end. Cable wiring is given in *Figure A-2*.

Connecting this cable to the FCD-E1LC E1/T1 MAIN connector will cause the interface to switch to the unbalanced mode.

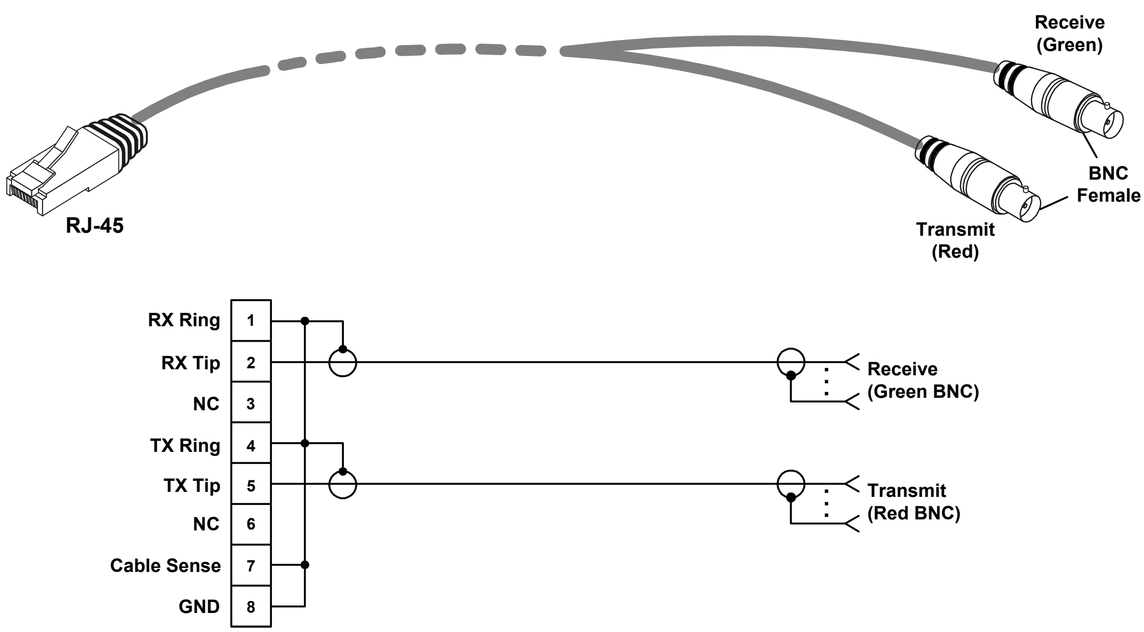


Figure A-2. Main Link Unbalanced Interface Adapter Cable, CBL-RJ45/2BNC/E1/X, Wiring Diagram

A.2 Sublink Connection Data

Connector Data

The sublink port is terminated in an eight-pin RJ-45 connector, designated E1/T1 SUB. *Table A-2* lists the pin assignment of the connector. See *Figure A-1* for identification of connector pins.

Table A-2. Sublink Connector, Pin Assignment

Pin	Function
1	Transmit data input (ring)
2	Transmit data input (tip)
3	Not connected
4	Receive data output (ring)
5	Receive data output (tip)
6	Not connected
7	Sense pin for detecting the connection of the unbalanced interface adapter cable
8	Ground

Connection Cable for Balanced Interface

The cable used for connecting equipment with balanced E1 interface to the FCD-E1LC sublink should include only two twisted pairs, one for the transmit path and the other for the receive path. The cable can usually be wired point-to-point, because the pins assigned to the receive and transmit pairs in the sublink connector have been interchanged relative to the main link connector.

The cable end intended for connection to the FCD-E1LC must be terminated in an RJ-45 plug. Make sure pin 7 in the RJ-45 plug is not connected: the sublink port will switch to the unbalanced interface if DC current can flow from pin 7 of the FCD-E1LC E1/T1 SUB connector to ground.

Connection Cable for Unbalanced Interface, CBL-RJ45/2BNC/E1

To connect equipment with unbalanced E1 interface to the FCD-E1LC sublink, RAD offers a 15-cm long adapter cable, CBL-RJ45/2BNC/E1, which has one RJ-45 plug for connection to FCD-E1LC E1/T1 SUB connector and two BNC female connectors at the other end. Cable wiring is given in *Figure A-3*.

Note *This cable has different wiring (crossed receive and transmit pins), relative to the cable intended for use on the FCD-E1LC main link (see Figure A-2).*

Connecting this cable to the FCD-E1LC E1/T1 SUB connector will cause the interface to switch to the unbalanced mode.

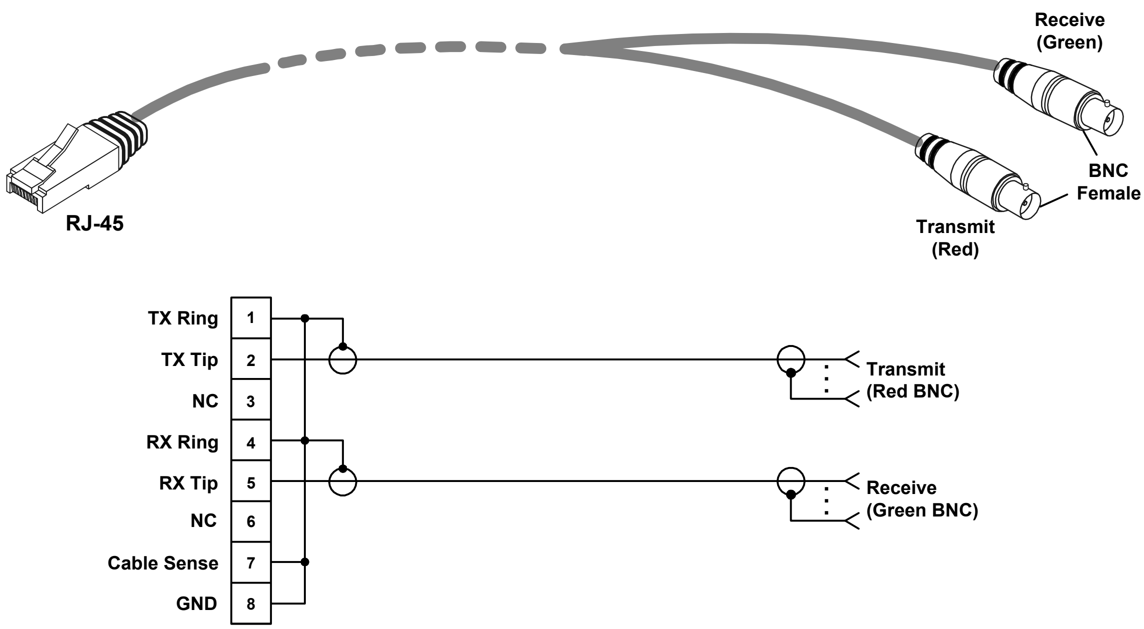


Figure A-3. Sublink Unbalanced Interface Adapter Cable, CBL-RJ45/2BNC/E1, Wiring Diagram

A.3 Data Channel Connection Data

Connector Data

Each synchronous data channel of the FCD-E1LC is terminated in a 25-pin D-type female connector, irrespective of the channel interface type. The connector pin assignment is given in *Table A-3*. *Figure A-4* identifies the pins of the data channel connector.

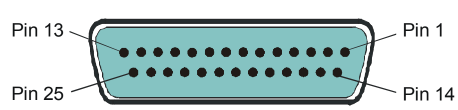


Figure A-4. Data Channel Connector, Pin Identification

Table A-3. Data Channel Connector, Pin Assignment

Pin	Direction	Designation	Function	RS-530 Circuit
1	↔	FG	Frame Ground	AA
2	Input	SDA	Send Data (wire A)	BA(A)
3	Output	RDA	Receive Data (wire A)	BB(A)
4	Input	RTSA	RTS (wire A)	CA(A)
5	Output	CTSA	CTS (wire A)	CB(A)
6	Output	DSRA	DSR (wire A)	CC(A)
7	↔	SG	Signal Ground	AB
8	Output	DCDA	DCD (wire A)	CF(A)
9	Output	RCB	Receive Clock (wire B)	DD(B)
10	Output	DCDB	DCD (wire B)	CF(B)
11	Input	SCEB	External Send Clock (wire B)	DA(B)
12	Output	SCB	Send Clock (wire B)	DB(B)
13	Output	CTSB	CTS (wire B)	CB(B)
14	Input	SDB	Send Data (wire B)	BA(B)
15	Output	SCA	Send Clock (wire A)	DB(A)
16	Output	RDB	Receive Data (wire B)	BB(B)
17	Output	RCA	Receive Clock (wire A)	DD(A)
18	Input	LLBA	Local Loopback Activation (wire A)	–
19	Input	RTSB	RTS (wire B)	CA(B)
20	Input	DTRA/RCEA	DTRA/External Receive Clock (wire A)	CD(A)
21	Input	RLBA	Remote Loopback Activation (wire A)	–
22	Output	DSRB	DSR (wire B)	CC(B)
23	Input	DTRB/RCEB	DTRB/External Receive Clock (wire B)	CD(B)
24	Input	SCEA	External Send Clock (wire A)	DA(A)
25	Output	TMA	Test Mode Indication (wire A)	–

Connection Data for Data Channel with RS-530 Interface

The functions of the pins in the RS-530 data channel interface connector are listed in *Table A-3*. The following sections provide information on the cables required to connect user's equipment to a data channel with RS-530 interface in the various timing modes.

DCE Mode

This mode is used to connect to user's equipment with DTE interface. The user's equipment can be directly connected to the FCD-E1LC channel connector using a standard "straight" RS-530 cable (i.e., a cable wired point-to-point). The "straight" cable is terminated in a 25-pin male D-type connector at the FCD-E1LC side.

DTE1 Mode

This mode is used to connect to user's equipment with DCE interface that can accept, as its external clock, the receive clock signal provided by the FCD-E1LC data channel.

In this case, it is necessary to connect a 25-pin male/25-pin male cross-cable (see *Figure A-5*) wired in accordance with *Table A-4*, between the FCD-E1LC CHANNEL connector and the user's equipment RS-530 connector.

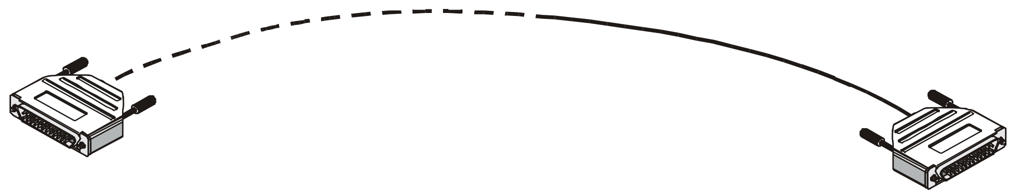


Figure A-5. RS-530 Adapter Cable for DTE1 Mode

Table A-4. Wiring of RS-530 Adapter Cable for DTE1 Mode

FCD-E1LC Side	Designation	Function	User's Side
1	FG	Frame Ground	1
2	SDA	Send Data (wire A)	3
3	RDA	Receive Data (wire A)	2
4	RTSA	RTS (wire A)	8
5	CTSA	CTS (wire A)	–
6	DSRA	DSR (wire A)	20
7	SG	Signal Ground	7
8	DCDA	DCD (wire A)	4
9	RCB	Receive Clock (wire B)	11
10	DCDB	DCD (wire B)	19
11	SCEB	External Send Clock (wire B)	9
12	SCB	Send Clock (wire B)	–
13	CTSB	CTS (wire B)	–
14	SDB	Send Data (wire B)	16
15	SCA	Send Clock (wire A)	–
16	RDB	Receive Data (wire B)	14
17	RCA	Receive Clock (wire A)	24
18	–	Not connected	–
19	RTSB	RTS (wire B)	10
20	RCEA	External Receive Clock (wire A)	–
21	–	Not connected	–
22	DSRB	DSR (wire B)	23

FCD-E1LC Side	Designation	Function	User's Side
23	RCEB	External Receive Clock (wire B)	–
24	SCEA	External Send Clock (wire A)	17
25	–	Not connected	–

DTE2 Mode

This mode is used to connect to user's equipment with DCE interface that provides the transmit and receive clocks to the FCD-E1LC data channel.

In this case, it is necessary to connect a 25-pin male/25-pin male cross-cable (see *Figure A-5*) wired in accordance with *Table A-5*, between the FCD-E1LC CHANNEL connector and the user's equipment RS-530 connector.

Table A-5. Wiring of RS-530 Adapter Cable for DTE2 Mode

FCD-E1LC Side	Designation	Function	User's Side
1	FG	Frame Ground	1
2	SDA	Send Data (wire A)	3
3	RDA	Receive Data (wire A)	2
4	RTSA	RTS (wire A)	8
5	CTSA	CTS (wire A)	–
6	DSRA	DSR (wire A)	20
7	SG	Signal Ground	7
8	DCDA	DCD (wire A)	4
9	RCB	Receive Clock (wire B)	–
10	DCDB	DCD (wire B)	19
11	SCEB	External Send Clock (wire B)	9
12	SCB	Send Clock (wire B)	–
13	CTSB	CTS (wire B)	–
14	SDB	Send Data (wire B)	16
15	SCA	Send Clock (wire A)	–
16	RDB	Receive Data (wire B)	14
17	RCA	Receive Clock (wire A)	–
18	–	Not connected	–
19	RTSB	RTS (wire B)	10
20	RCEA	External Receive Clock (wire A)	15
21	–	Not connected	–
22	DSRB	DSR (wire B)	23

FCD-E1LC Side	Designation	Function	User's Side
23	RCEB	External Receive Clock (wire B)	12
24	SCEA	External Send Clock (wire A)	17
25	–	Not connected	–

Connection Data for Data Channel with V.35 Interface

The following sections provide information on the cables required to connect user's equipment to a data channel with V.35 interface in the various timing modes.

DCE Mode

This mode is used to connect to user's equipment with V.35 DTE interface. The V.35 cable coming from the user's equipment is connected to the FCD-E1LC CHANNEL connector through an adapter cable. The adapter cable (see *Figure A-6*) is terminated in a 25-pin male D-type connector at the FCD-E1LC side, and a 34-pin female connector at the user's side. A suitable cable, designated CBL-HS2V1, is available from RAD.

Cable wiring is given in *Table A-6*.

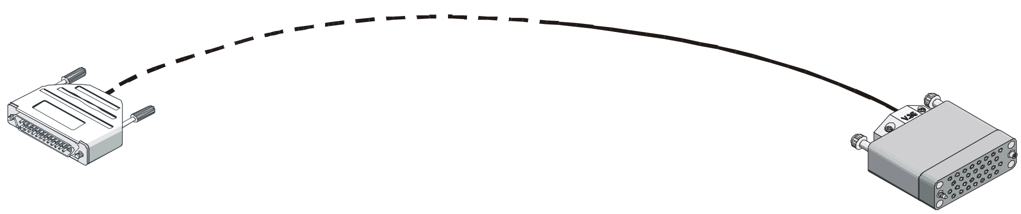


Figure A-6. V.35 Adapter Cable for DCE Mode

Table A-6. Wiring of V.35 Adapter Cable for DCE Mode

FCD-E1LC Side	Designation	Function	User's Side
1	FG	Frame Ground	A
2	SDA	Send Data (wire A)	P
3	RDA	Receive Data (wire A)	R
4	RTSA	RTS (wire A)	C
5	CTSA	CTS (wire A)	D
6	DSRA	DSR (wire A)	E
7	SG	Signal Ground	B
8	DCDA	DCD (wire A)	F
9	RCB	Receive Clock (wire B)	X
10	DCDB	DCD (wire B)	–
11	SCEB	External Send Clock (wire B)	W
12	SCB	Send Clock (wire B)	AA

FCD-E1LC Side	Designation	Function	User's Side
13	CTSB	CTS (wire B)	–
14	SDB	Send Data (wire B)	S
15	SCA	Send Clock (wire A)	Y
16	RDB	Receive Data (wire B)	T
17	RCA	Receive Clock (wire A)	V
18	–	Not connected	–
19	RTSB	RTS (wire B)	–
20	RCEA	External Receive Clock (wire A)	–
21	–	Not connected	–
22	DSRB	DSR (wire B)	–
23	RCEB	External Receive Clock (wire B)	–
24	SCEA	External Send Clock (wire A)	U
25	–	Not connected	–

DTE1 Mode

This mode is used to connect to user's equipment with V.35 DCE interface that can accept, as its external clock, the receive clock signal provided by the FCD-E1LC data channel.

The V.35 cable coming from the user's equipment is connected to the FCD-E1LC CHANNEL connector through an adapter cable. The adapter cable (see *Figure A-6*) is terminated in a 25-pin male D-type connector at the FCD-E1LC side, and a 34-pin female connector at the user's side. A suitable cable, designated CBL-HS2V2, is available from RAD.

Cable wiring is given in *Table A-7*.

Table A-7. Wiring of V.35 Adapter Cable for DTE1 Mode

FCD-E1LC Side	Designation	Function	User's Side
1	FG	Frame Ground	A
2	SDA	Send Data (wire A)	R
3	RDA	Receive Data (wire A)	P
4	RTSA	RTS (wire A)	F
5	CTSA	CTS (wire A)	–
6	DSRA	DSR (wire A)	H
7	SG	Signal Ground	B
8	DCDA	DCD (wire A)	C
9	RCB	Receive Clock (wire B)	W
10	DCDB	DCD (wire B)	–

FCD-E1LC Side	Designation	Function	User's Side
11	SCEB	External Send Clock (wire B)	X
12	SCB	Send Clock (wire B)	–
13	CTSB	CTS (wire B)	–
14	SDB	Send Data (wire B)	T
15	SCA	Send Clock (wire A)	–
16	RDB	Receive Data (wire B)	S
17	RCA	Receive Clock (wire A)	U
18	–	Not connected	–
19	RTSB	RTS (wire B)	–
20	RCEA	External Receive Clock (wire A)	–
21	–	Not connected	–
22	DSRB	DSR (wire B)	–
23	RCEB	External Receive Clock (wire B)	–
24	SCEA	External Send Clock (wire A)	V
25	–	Not connected	–

DTE2 Mode

This mode is used to connect to user's equipment with V.35 DCE interface that provides the transmit and receive clocks to the FCD-E1LC data channel.

The V.35 cable coming from the user's equipment is connected to the FCD-E1LC CHANNEL connector through an adapter cable. The adapter cable (see *Figure A-6*) is terminated in a 25-pin male D-type connector at the FCD-E1LC side, and a 34-pin female connector at the user's side. A suitable cable, designated CBL-HS2V3, is available from RAD.

Cable wiring is given in *Table A-8*.

Table A-8. Wiring of V.35 Adapter Cable for DTE2 Mode

FCD-E1LC Side	Designation	Function	User's Side
1	FG	Frame Ground	A
2	SDA	Send Data (wire A)	R
3	RDA	Receive Data (wire A)	P
4	RTSA	RTS (wire A)	F
5	CTSA	CTS (wire A)	–
6	DSRA	DSR (wire A)	H
7	SG	Signal Ground	B
8	DCDA	DCD (wire A)	C

FCD-E1LC Side	Designation	Function	User's Side
9	RCB	Receive Clock (wire B)	–
10	DCDB	DCD (wire B)	–
11	SCEB	External Send Clock (wire B)	X
12	SCB	Send Clock (wire B)	–
13	CTSB	CTS (wire B)	–
14	SDB	Send Data (wire B)	T
15	SCA	Send Clock (wire A)	–
16	RDB	Receive Data (wire B)	S
17	RCA	Receive Clock (wire A)	–
18	–	Not connected	–
19	RTSB	RTS (wire B)	–
20	RCEA	External Receive Clock (wire A)	Y
21	–	Not connected	–
22	DSRB	DSR (wire B)	–
23	RCEB	External Receive Clock (wire B)	AA
24	SCEA	External Send Clock (wire A)	V
25	–	Not connected	–

X.21 Data Channel

For the X.21 port, only a cable for use in the DCE mode designated CBL-HS2X1 is available from RAD.

This mode is used to connect to user's equipment with X.21 DTE interface. The X.21 cable coming from the user's equipment is connected to the FCD-E1LC CHANNEL connector through an adapter cable. The adapter cable (see *Figure A-7*) is terminated in a 25-pin male D-type connector at the FCD-E1LC side, and a 15-pin female connector at the user's side.

Cable wiring is given in *Table A-9*.

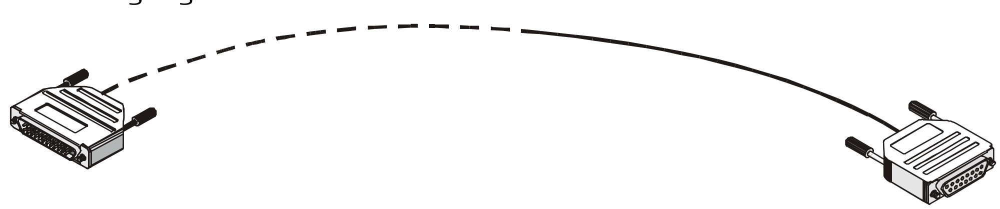


Figure A-7. X.21 Adapter Cable for DCE Mode

Table A-9. Wiring of X.21 Adapter Cable for DCE Mode

FCD-E1LC Side	Designation	Function	User's Side
1	FG	Frame Ground	1
2	SDA	Send Data (wire A)	2
3	RDA	Receive Data (wire A)	4
4	RTSA	RTS (wire A)	3
5	CTSA	CTS (wire A)	–
6	DSRA	DSR (wire A)	–
7	SG	Signal Ground	8
8	DCDA	DCD (wire A)	5
9	RCB	Receive Clock (wire B)	–
10	DCDB	DCD (wire B)	12
11	SCEB	External Send Clock (wire B)	–
12	SCB	Send Clock (wire B)	13
13	CTSB	CTS (wire B)	–
14	SDB	Send Data (wire B)	9
15	SCA	Send Clock (wire A)	6
16	RDB	Receive Data (wire B)	11
17	RCA	Receive Clock (wire A)	–
18	–	Not connected	–
19	RTSB	RTS (wire B)	10
20	RCEA	External Receive Clock (wire A)	–
21	–	Not connected	–
22	DSRB	DSR (wire B)	–
23	RCEB	External Receive Clock (wire B)	–
24	SCEA	External Send Clock (wire A)	–
25	–	Not connected	–

Connection Data for Data Channel with V.36/RS-449 Interface

The following sections provide information on the cables required to connect user's equipment to a data channel with V.36/RS-449 interface in the various timing modes.

DCE Mode

This mode is used to connect to user's equipment with V.36/RS-449 DTE interface. The V.36/RS-449 cable coming from the user's equipment is connected to the FCD-E1LC CHANNEL connector through an adapter cable. The adapter cable (see *Figure A-8*) is terminated in a 25-pin male D-type connector at the FCD-E1LC side, and a 37-pin female connector at the user's side. A suitable cable, designated CBL-HS2R1, is available from RAD.

Cable wiring is given in *Table A-10*.

Figure A-8. V.36/RS-449 Adapter Cable for DCE Mode

Table A-10. Wiring of V.36/RS-449 Adapter Cable for DCE Mode

FCD-E1LC Side	Designation	Function	User's Side
1	FG	Frame Ground	1
2	SDA	Send Data (wire A)	4
3	RDA	Receive Data (wire A)	6
4	RTSA	RTS (wire A)	7
5	CTSA	CTS (wire A)	9
6	DSRA	DSR (wire A)	11
7	SG	Signal Ground	19
8	DCDA	DCD (wire A)	13
9	RCB	Receive Clock (wire B)	26
10	DCDB	DCD (wire B)	31
11	SCEB	External Send Clock (wire B)	35
12	SCB	Send Clock (wire B)	23
13	CTSB	CTS (wire B)	27
14	SDB	Send Data (wire B)	22
15	SCA	Send Clock (wire A)	5
16	RDB	Receive Data (wire B)	24
17	RCA	Receive Clock (wire A)	8
18	–	Not connected	–
19	RTSB	RTS (wire B)	25
20	RCEA	External Receive Clock (wire A)	

FCD-E1LC Side	Designation	Function	User's Side
21	–	Not connected	–
22	DSRB	DSR (wire B)	29
23	RCEB	External Receive Clock (wire B)	–
24	SCEA	External Send Clock (wire A)	17
25	–	Not connected	–

DTE1 Mode

This mode is used to connect to user's equipment with V.36/RS-449 DCE interface that can accept, as its external clock, the receive clock signal provided by the
FCD-E1LC data channel.

The V.36/RS-449 cable coming from the user's equipment is connected to the FCD-E1LC CHANNEL connector through an adapter cable. The adapter cable (see *Figure A-8*) is terminated in a 25-pin male D-type connector at the FCD-E1LC side, and a 37-pin female connector at the user's side. A suitable cable, designated CBL-HS2R2, is available from RAD.

Cable wiring is given in *Table A-11*.

Table A-11. Wiring of V.36/RS-449 Adapter Cable for DTE1 Mode

FCD-E1LC Side	Designation	Function	User's Side
1	FG	Frame Ground	1
2	SDA	Send Data (wire A)	6
3	RDA	Receive Data (wire A)	4
4	RTSA	RTS (wire A)	13
5	CTSA	CTS (wire A)	–
6	DSRA	DSR (wire A)	12
7	SG	Signal Ground	19
8	DCDA	DCD (wire A)	7
9	RCB	Receive Clock (wire B)	35
10	DCDB	DCD (wire B)	25
11	SCEB	External Send Clock (wire B)	26
12	SCB	Send Clock (wire B)	–
13	CTSB	CTS (wire B)	–
14	SDB	Send Data (wire B)	24
15	SCA	Send Clock (wire A)	–
16	RDB	Receive Data (wire B)	22
17	RCA	Receive Clock (wire A)	17

FCD-E1LC Side	Designation	Function	User's Side
18	–	Not connected	–
19	RTSB	RTS (wire B)	31
20	RCEA	External Receive Clock (wire A)	–
21	–	Not connected	–
22	DSRB	DSR (wire B)	24
23	RCEB	External Receive Clock (wire B)	–
24	SCEA	External Send Clock (wire A)	8
25	–	Not connected	–

DTE2 Mode

This mode is used to connect to user's equipment with V.36/RS-449 DCE interface that provides the transmit and receive clocks to the FCD-E1LC data channel.

The V.36/RS-449 cable coming from the user's equipment is connected to the FCD-E1LC CHANNEL connector through an adapter cable. The adapter cable (see *Figure A-8*) is terminated in a 25-pin male D-type connector at the FCD-E1LC side, and a 37-pin female connector at the user's side. A suitable cable, designated CBL-HS2R3, is available from RAD.

Cable wiring is given in *Table A-12*.

Table A-12. Wiring of V.36/RS-449 Adapter Cable for DTE2 Mode

FCD-E1LC Side	Designation	Function	User's Side
1	FG	Frame Ground	1
2	SDA	Send Data (wire A)	6
3	RDA	Receive Data (wire A)	4
4	RTSA	RTS (wire A)	13
5	CTSA	CTS (wire A)	–
6	DSRA	DSR (wire A)	12
7	SG	Signal Ground	19
8	DCDA	DCD (wire A)	7
9	RCB	Receive Clock (wire B)	–
10	DCDB	DCD (wire B)	25
11	SCEB	External Send Clock (wire B)	26
12	SCB	Send Clock (wire B)	–
13	CTSB	CTS (wire B)	–
14	SDB	Send Data (wire B)	24

FCD-E1LC Side	Designation	Function	User's Side
15	SCA	Send Clock (wire A)	–
16	RDB	Receive Data (wire B)	22
17	RCA	Receive Clock (wire A)	–
18	–	Not connected	–
19	RTSB	RTS (wire B)	31
20	RCEA	External Receive Clock (wire A)	5
21	–	Not connected	–
22	DSRB	DSR (wire B)	24
23	RCEB	External Receive Clock (wire B)	23
24	SCEA	External Send Clock (wire A)	8
25	–	Not connected	–

A.4 V.24 Interface Connector

The DHS module with the V.24 interface is supplied with a 25-pin D-type female connector. The pin allocation in the V.24 interface connector is given in *Figure A-9* identifies the pins of the V.24 connector.

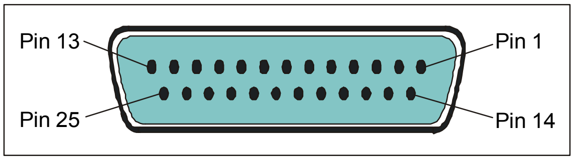


Figure A-9. V.24 Connector, Pin Identification

Table A-13. V.24 Connector Wiring

Pin	Designation	Direction	Function
1	FGND	–	Frame ground
2	TD	IN	TX data
3	RD	OUT	RX data
4	RTS	IN	Request to send
5	CTS	OUT	Clear to send
6	DSR	OUT	Data set ready
7	SGND	–	Signal ground
8	DCD	OUT	Carrier detect
9	NC	–	–
10	NC	–	–
11	NC	–	–
12	NC	–	–
13	NC	–	–
14	NC	–	–
15	TC	OUT	TX CLK
16	NC	–	–
17	RC	OUT	RX CLK
18	LLB	IN	Local loop
19	NC	–	–
20	ERC	OUT	External RX CLK
21	RLB	IN	Remote loop
22	NC	–	–
23	NC	–	–
24	ETC	IN	External TX CLK
25	TM	OUT	Test mode

A.5 CONTROL DCE Connection Data

Connector Data

The CONTROL DCE port has an RS-232 DCE interface, intended for direct connection to a supervision terminal that is terminated in a 9-pin D-type female connector. CONTROL DCE pin assignment is given in *Table A-14*.

Table A-14. CONTROL DCE Connector Wiring

Pin	Function	Direction
1	Data Carrier Detect (DCD)	From FCD-E1LC
2	Receive Data (RD)	From FCD-E1LC
3	Transmit Data (TD)	To FCD-E1LC
4	Data Terminal Ready (DTR)	To FCD-E1LC
5	Ground (GND)	↔
6	Data Set Ready (DSR)	From FCD-E1LC
7	Request to Send (RTS)	To FCD-E1LC
8	Clear to Send (CTS)	From FCD-E1LC
9	Ring Indicator (RI)	To FCD-E1LC

Connection Data

The connection of the CONTROL DCE connector to a supervision terminal having a 9-pin D-type connector is made by means of a straight cable (a cable wired point-to-point).The connection to a terminal with 25-pin D-type female connector is made by means of a crossed cable, wired in accordance with *Figure A-10*.

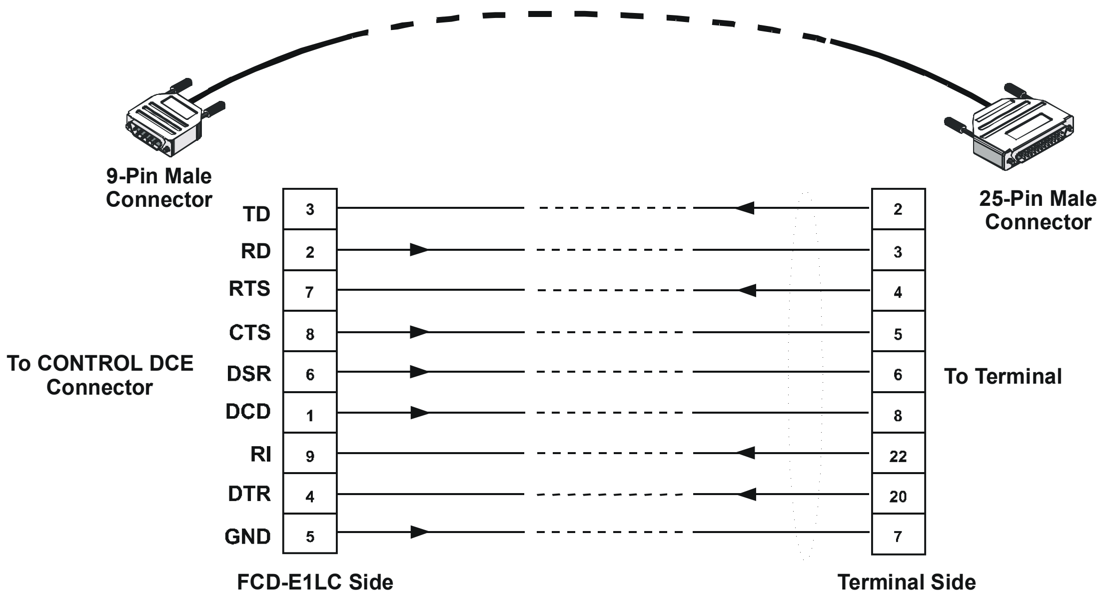


Figure A-10. 25-Pin Terminal Cable Wiring – Connection to CONTROL DCE Connector

A.6 Ethernet Port Connection Data

The optional Ethernet port has a 10/100Base-T Ethernet interface terminated in an RJ-45 connector, designated 10/100BASE-T. The port supports automatic MDI/MDIX detection and crossover, and therefore can be connected by any type of cable (standard or cross-over) to any type of 10/100Base-T Ethernet port (station or hub). The connector pin functions corresponding to the standard hub pinout are listed in *Table A-15*.

Table A-15. ETH Interface Connector, Pin Functions

Pin	Designation	Function
1	RxD+	Receive Data input, + wire
2	RxD–	Receive Data input, – wire
3	TxD+	Transmit Data output, + wire
4, 5	–	Not connected
6	TxD–	Transmit Data output, – wire
7, 8	–	Not connected

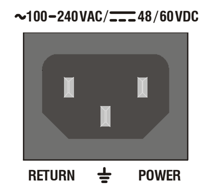
A.7 Power Connection

Connector Data

FCD-E1LC units have one standard IEC three-pin socket for connection to power (either DC or AC). Connector wiring is listed in *Table A-16*, together with a view of the connector itself.

Table A-16. Power Connector Pin Functions

Pin	Function with AC Power Source	Function with DC Power Source
1	Return (0V)	Ground (0V)
2	Chassis (Frame) Ground	Chassis (Frame) Ground
3	Phase (Power)	-48/-60 VDC



AC/DC Adapter Plug

The connection of the FCD-E1LC to a DC power source is made by means of a special AC/DC adapter plug. This adapter, which plugs into the FCD-E1LC power connector, has internal wire terminals for connecting the leads of the DC power cable. See description of AC/DC adapter plug and instructions for connecting a DC power cable in the RAD *Supplement SUP-930: DC Power Supply Connection – AC/DC Adapter (AD) Plug*.

Appendix B

SNMP Management

This appendix provides specific information related to the management of FCD-E1LC units by means of the Simple Network Management Protocol (SNMP). Some of the information presented in this Appendix is also applicable for management using Telnet.

The information presented in this Appendix is organized as follows:

- Description of SNMP environment – *Section B.1*
- SNMP traps supported by FCD-E1LC – *Section B.2*
- Information on the handling of inband and out-of-band SNMP and Telnet management traffic by the FCD-E1LC internal SNMP agent – *Section B.3.*

B.1 SNMP Environment

General

The SNMP management functions of the FCD-E1LC are provided by an internal SNMP agent, which can use inband and out-of-band communication (see *Section B.3*).

The SNMP management communication uses the User Datagram Protocol (UDP), which is a connectionless-mode transport protocol, part of the suite of protocols of the Internet Protocol (IP).

Note *Telnet management uses the TCP protocol over IP for management communication. After a Telnet session is started, the management interface is similar to that used for the supervision terminal.*

SNMP Principles

The SNMP management protocol is an asynchronous command/response polling protocol: the SNMP-based network management station, which addresses the managed entities in its management domain, initiates all the management traffic. Only the addressed managed entity answers the polling of the management station (except for trap messages).

The managed entities include a function called an “SNMP agent”, which is responsible for the interpretation and handling of the management station requests to the managed entity, and the generation of properly-formatted responses to the management station.

SNMP Operations

The SNMP protocol includes four types of operations:

getRequest	Command for retrieving specific management information from the managed entity. The managed entity responds with a **getResponse** message.
getNextRequest	Command for retrieving sequentially specific management information from the managed entity. The managed entity responds with a **getResponse** message.
setRequest	Command for manipulating specific management information within the managed entity. The managed entity responds with a **setResponse** message.
trap	Management message carrying unsolicited information on extraordinary events (e.g., alarms) reported by the managed entity.

The Management Information Base

The management information base (MIB) includes a collection of ***managed objects***. A managed object is defined as a parameter that can be managed, such as a performance statistics value.

The MIB includes the definitions of relevant managed objects. Various MIBs can be defined for various management purposes, types of equipment, etc.

An object's definition includes the range of values and the "access" rights:

Read-only	Object value can be read, but cannot be set.
Read-write	Object value can be read or set.
Write-only	Object value can be set, but cannot be read.
Not accessible	Object cannot be read, nor set.

MIB Structure

The MIB has an inverted tree-like structure, with each definition of a managed object forming one leaf, located at the end of a branch of that tree. A unique path reaches each "leaf" in the MIB, therefore by numbering the branching points, starting with the top, each leaf can be uniquely defined by a sequence of numbers.

The formal description of the managed objects and the MIB structure is provided in a special standardized format, called Abstract Syntax Notation 1 (ASN.1).

Since the general collection of MIBs can also be organized in a similar structure, under the supervision of the Internet Activities Board (IAB), any parameter included in a MIB that is recognized by the IAB is uniquely defined.

To provide the flexibility necessary in a global structure, MIBs are classified in various classes (branches), one of them being the experimental branch, and another the group of private (enterprise-specific) branch.

Under the private (enterprise-specific) branch of MIBs, each enterprise (manufacturer) can be assigned a number, which is its enterprise number.

The assigned number designates the top of an enterprise-specific sub-tree of non-standard MIBs. Within this context, RAD has been assigned the enterprise number 164. Therefore, enterprise MIBs published by RAD can be found under **1.3.6.1.4.1.164**.

MIBs of general interest are published by the IAB in the form of a Request for Comment (RFC) document. In addition, MIBs are also often assigned informal names that reflect their primary purpose. Enterprise-specific MIBs are published and distributed by their originator, which is responsible for their contents.

MIBs Supported by the FCD-E1LC SNMP Agent

The interpretation of the relevant MIBs is a function of the SNMP agent of each managed entity. The general MIBs supported by the FCD-E1LC SNMP agent are as follows:

- RFC 1213 (standard MIB-II).
- RFC 1406 (standard E1/T1 MIB).

In addition, the FCD-E1LC SNMP agent supports the RAD-private (enterprise-specific) MIB identified as (read the following as a continuous string):
iso(1).org(3).dod(6).internet(1).private(4).enterprises(1).
rad(164).radGen(6).systems(1).radSysWAN(3).radFcdE1LC(27)

Enterprise-specific MIBs supported by RAD equipment, including those for the FCD-E1LC, are available in ASN.1 format from the RAD Technical Support Department.

Management Domains Under SNMP

In principle, SNMP enables any management station that knows the MIBs supported by a device to perform all the management operations available on that device. However, this is not desirable in practical situations, so it is necessary to provide a means to delimit management domains.

SNMP Communities

To enable the delimitation of management domains, SNMP uses “communities”. Each community is identified by a name, which is an alphanumeric string defined by the user.

Any SNMP entity (this term includes both managed entities and management stations) is assigned by its user a community name.

Access Restriction Using SNMP Communities

In general, SNMP agents support two types of access rights:

- Read-only: the SNMP agent accepts and processes only SNMP getRequest and getNextRequest commands from management stations which have the same read-only community name.
- Read-write: the SNMP agent accepts and processes all the SNMP commands received from a management station with the same write community name.

In accordance with the SNMP protocol, the SNMP community of the originating entity is sent in each message.

When an SNMP message is received by the addressed entity, first it checks the originator's community. If the community name of the message originator differs from the community name specified for that type of message in the agent, the message it discarded (SNMP agents of managed entities report this event by means of an authentication failure trap).

FCD-E1LC Communities

The SNMP agents of FCD-E1LC are programmed to recognize the following community types:

Read	SNMP community that has read-only authorization, i.e., the SNMP agent will accept only getRequest and getNextRequest commands from management stations using that community.
Write	SNMP community that has read-write authorization, i.e., the SNMP agent will also accept setRequest commands from management stations using that community.
Trap	SNMP community that the SNMP agent will send within trap messages.

B.2 SNMP Traps

The FCD-E1LC SNMP agent supports the standard MIB-II traps.

B.3 Handling the Management Traffic

The FCD-E1LC management subsystem includes an SNMP agent.

The SNMP agent receives the management traffic through an internal router. This router fulfills two main requirements:

- Ensures that the SNMP agent can receive and transmit management traffic through all the inband and out-of-band management ports of the FCD-E1LC, in accordance with user’s selections.
- Provides paths that enable management traffic received through one of the FCD-E1LC ports to reach equipment connected to the other ports, as explained below.

The following sections explain the way management traffic is handled by the FCD-E1LC.

Note *The management traffic handling capabilities described below are also applicable to Telnet traffic.*

Configuring the Out-of-Band Communication Mode

Out-of-band management communication uses the CONTROL DCE port.

To select the management mode, use the **DEF SP** command. Configure the **AUXILIARY_DEVICE** parameter as follows:

- TERMINAL – when only the ASCII supervision terminal must be supported.
- SLIP-AGENT – when the supervisory port must support the SLIP protocol, and is connected to the management station through another serial port that supports SLIP (for example, the CONTROL DTE port of a Megaplex-2100/2104).

  In the SLIP-AGENT mode, the FCD-E1LC management traffic router generates and accepts routing (RIP) requests and updates, and therefore it can determine whether to send or not management traffic through the serial port.
- NMS-SLIP – when the supervisory port must support the SLIP protocol, for example SNMP or Telnet management, and is connected directly to the SNMP management station or Telnet host.

  The FCD-E1LC management traffic router will not accept routing information messages when the port is configured as NMS-SLIP port.
- NMS-PPP – when the supervisory port must support the PPP protocol, for example SNMP or Telnet management.

Configuring the Inband Communication Mode

Inband communication is supported through the main link.

For an FCD-E1LC equipped with a sublink, inband management is also possible through this link.

Note *Although the FCD-E1LC can accept and transfer management traffic toward the sublink, this capability is provided only for enabling the management of the equipment unit directly connected to the sublink through the FCD-E1LC main link, or through the FCD-E1LC serial port. Therefore, the FCD-E1LC is not intended to handle heavy management traffic (as needed to manage a network of managed devices) toward the sublink.*

Inband Communication Ports and Protocols

When using inband communication, you can select between the following transmission protocols:

- Management traffic carried within the E1 frame overhead. This communication mode uses the RAD proprietary protocol, which requires a small bandwidth: the management traffic is carried by means of the national bits, S_{a4} through S_{a8}, in timeslot 0 (each bit can carry a data rate of 4 kbps).
- Management traffic carried in a dedicated timeslot. In addition to the RAD proprietary protocol, this communication mode supports Frame Relay encapsulation in accordance with RFC 1490.

  When a dedicated timeslot is used, the management data rate is 64 kbps.

Inband Management Traffic Routing

The FCD-E1LC management traffic router uses the RAD proprietary routing protocol whenever it operates in a network environment consisting of RAD products.

In addition, you can configure the management traffic router to use standard protocols (such as frame relay), when connecting directly to a router.

- The RAD proprietary routing protocol is used with timeslot 0 and the dedicated timeslot option.

  When the IP router function is configured to use the RAD proprietary protocol, it collects information on the other SNMP agents by exchanging routing information (including the contents of each router's routing table), with its neighbors. This automatic learning capability enables using any network topology, including topologies with closed loops.

- When the management traffic is carried in a dedicated timeslot, Frame Relay encapsulation in accordance with RFC 1490 is also used. This enables Frame Relay routers to carry the management traffic to the managed FCD-E1LC.

  Frame Relay encapsulation is used as follows:

  - In the transmit direction, the SNMP agent encapsulates the management messages in frames with a predetermined DLCI (always DLCI 100), and sends them at the selected rate through the selected main and/or sublink timeslot.
  - In the receive direction, the SNMP agent monitors the specified timeslot, analyzes packets received with DLCI 100, and analyzes the received data to detect management messages (any such messages are then processed as usual).

Note *The FCD-E1LC management traffic router does not support Frame Relay management protocols (ANSI T1.617 Annex D, LMI, etc.), nor is such support required.*

The RAD proprietary protocol is more bandwidth-efficient, therefore it is recommended to use it whenever feasible. However, its bandwidth is limited and therefore it cannot be used when a high management traffic load is expected (for example, when management traffic directed to many other RAD equipment units passes though the FCD-E1LC main link).

Appendix C

Operating Environment

This appendix presents a concise description of the operating environment of FCD-E1LC systems, to provide the background information required for understanding the FCD-E1LC configuration and performance monitoring parameters.

This Appendix covers the following issues:

- E1 environment – *Section A.2*.
- IP environment – *Section A.3*.
- Ethernet transmission technology – *Section A.4*.

C.1 E1 Environment

The E1 line interfaces of FCD-E1LC comply with the applicable requirements of ITU-T Rec. G.703, G.704, G.711, G.732, G.736 and G.823.

E1 Signal Structure

The E1 line operates at a nominal rate of 2.048 Mbps, using a line signal encoded according to High-Density Bipolar 3 (HDB3) code. The data transferred over the E1 line is organized in frames. Each E1 frame includes 256 bits.

The E1 frame format is shown in *Figure A-1*.

The 256 bits included in a frame are organized of 32 timeslots of eight bits each. The frame repetition rate is 8,000 per second, therefore the data rate supported by each timeslot is 64 kbps. The number of timeslots available for user data is maximum 31, because timeslot 0 is always used for frame synchronization.

The frames are organized in larger patterns, called multiframes. Two types of multiframes are generally used:

- G732N (also called 256N) multiframes.
- G732S (also called 256S) multiframes.

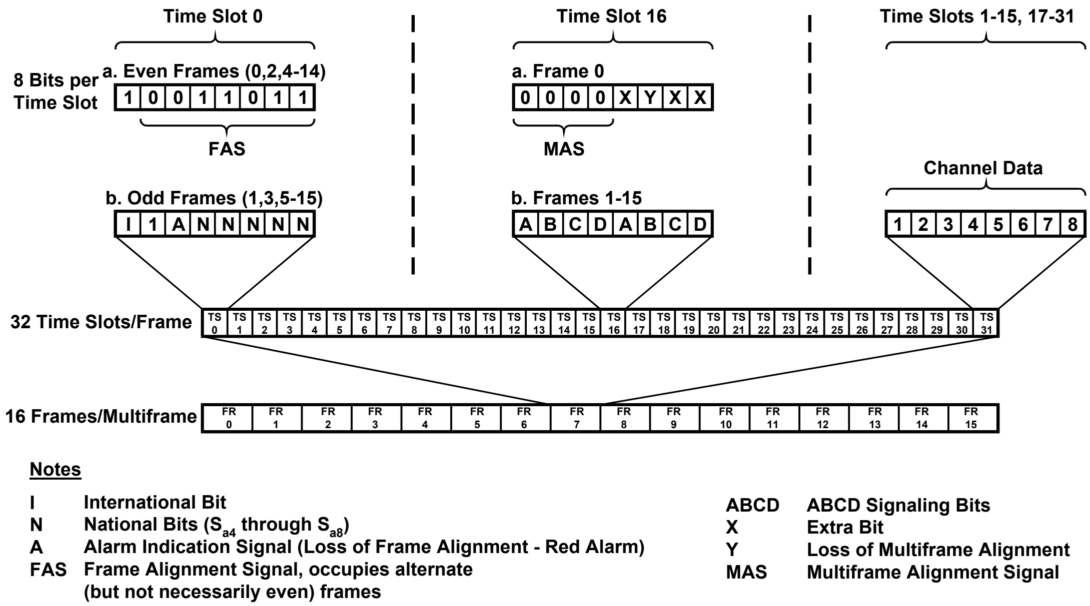


Figure C-1. E1 Frame Format

G732N Multiframe

The G732N multiframe structure consists of two frames, which are identified by means of the information included in timeslot 0:

- The even frame of the pair includes the frame alignment signal (FAS).
- The odd frame includes a "1" in bit position 2, and housekeeping information in the other bits.

The number of timeslots available for user's data is 31, and therefore the maximum payload rate is 1984 kbps.

G732S Multiframe

The G732S multiframe includes 16 frames, which are identified by means of a separate multiframe alignment signal (MAS) contained in timeslot 16 of frame number 0 of each multiframe.

Since timeslot 16 must be reserved for the transmission of the MAS and system signaling, only 30 timeslots are available for the user's payload, and the maximum payload rate is 1920 kbps.

When using the G732S multiframe format, timeslots 16 in the 16 frames of each multiframe carry the following information:

- The first four bits of timeslot 16 of frame number 0 in multiframe 16 always carry the multiframe alignment sequence, 0000.
- Bit 6 in timeslot 16 of frame number 0 in multiframe 16 is used to notify the equipment at the other end of the link that the local equipment lost multiframe alignment.
- The other bits of this timeslot are not assigned mandatory functions.

E1 Line Signal

The E1 line signal uses the High-Density Bipolar 3 (HDB3) code. The HDB3 coding format is an improvement of the alternate mark inversion (AMI) code.

In the AMI format, “ones” are alternately transmitted as positive and negative pulses, whereas “zeros” are transmitted as a zero voltage level. The AMI format cannot transmit long strings of “zeros”, because such strings do not carry timing information.

The HDB3 coding rules restrict the maximum length of a “zero” string to three pulse intervals.

Longer strings are encoded at the transmit end to introduce non-zero pulses. To allow the receiving end to detect the artificially introduced pulses and enable their removal to restore the original data string, the encoding introduces intentional bipolar violations in the data sequence. The receiving end detects these violations and when they appear to be part of an encoded “zero” string – it removes them.

Other bipolar violations may also be caused by transmission errors. Therefore, any bipolar violations which cannot be interpreted as intentional coding violations can be separately counted, to obtain information on the quality of the transmission link.

Timeslot 0

Timeslot 0 of E1 frames is used for two main purposes:

- Delineation of frame boundaries. For this purpose, in every second frame, timeslot 0 carries a fixed pattern, called frame alignment signal (FAS). Frames carrying the FAS are defined as even frames, as they are assigned the numbers 0, 2, 4, etc. when larger structures (multiframes) are used.

  The receiving equipment searches for the fixed FAS pattern in the data stream using a special algorithm, a process called frame synchronization. Once this process is successfully completed, the equipment can identify each bit in the received frames.

- Interchange of housekeeping information. In every frame without FAS (odd frames), timeslot 0 carries housekeeping information. This information is carried as follows:
  - Bit 1 - this bit is called the international (I) bit. Its main use is for error detection using the optional CRC-4 function (CRC-4 stands for Cyclic Redundancy Check, using a fourth-degree polynomial). This function is described below.
  - Bit 2 is always set to 1, a fact used by the frame alignment algorithm.
  - Bit 3 is used as a remote alarm indication (RAI), to notify the equipment at the other end that the local equipment lost frame alignment, or does not receive an input signal.
  - The other bits, identified as S_{a4} through S_{a8}, are designated ***national bits***, and are actually available to the users, provided agreement is reached as to their use. RAD equipment with SNMP agents can use S_a bits for

carrying the inband management traffic. The total data rate that can be carried by a national bit is 4 kbps.

E1 Line Statistics Using CRC-4 Error Detection

FCD-E1LC supports the CRC-4 function in accordance with ITU-T Rec. G.704. The CRC-4 function is used to detect errors in the received data, and therefore can be used to evaluate data transmission quality over E1 links. This function can be enabled or disabled by the user.

To enable error detection, additional information must be provided to the receiving equipment. The additional information is transmitted to the receiving equipment by using a multiframe structure called ***CRC-4 multiframes.***

A CRC-4 multiframe is an arbitrary group of 16 frames. This group is not related in any way to the G732S 16-frame multiframe structures explained above.

A CRC-4 multiframe always starts with an even frame (a frame that carries the frame alignment signal). The CRC-4 multiframe structure is identified by a six-bit ***CRC-4 multiframe alignment signal,*** which is multiplexed into bit 1 of timeslot 0 of each odd-numbered (1, 3, 5, etc.) frame of the CRC-4 multiframe (i.e., in frames 1 through 11 of the CRC-4 multiframe).

Each CRC-4 multiframe is divided into two submultiframes of 8 frames (2048 bits) each. The detection of errors is achieved by calculating a four-bit checksum on each 2048-bit block (submultiframe). The four-checksum bits calculated on a given submultiframe are multiplexed, bit by bit, in bit 1 of timeslot 0 of each even-numbered frame of the next submultiframe.

At the receiving end, the checksum is calculated again on each submultiframe and then compared against the original checksum (sent by the transmitting end in the next submultiframe). The results are reported by two bits multiplexed in bit 1 of timeslot 0 in frames 13, 15 of the CRC-4 multiframe, respectively. Errors are counted and used to prepare statistic data on transmission performance.

E1 Line Alarm Conditions

- Excessive bit error rate. The bit error rate is measured on the frame alignment signal. The alarm threshold is an error rate higher than 10^{-3} that persists for 4 to 5 seconds. The alarm condition is canceled when the error rate decreases below 10^{-4} for 4 to 5 consecutive seconds.
- Loss of frame alignment (also called loss of synchronization). This condition is declared when too many errors are detected in the frame alignment signal (FAS), e.g., when 3 or 4 FAS errors are detected in the last 5 frames. Loss of frame alignment is cleared after no FAS errors are detected in two consecutive frames. The loss of frame alignment is reported by means of the A bit (see *Figure A-1*).

Note *The A bit (bit 3 in timeslot 0 of the odd frames) serves as a remote alarm indicator (RAI) notifying the other end equipment that the local equipment lost frame alignment or does not receive an input signal.*

- **Loss of multiframe alignment** (applicable only when G732S multiframes are used). This condition is declared when too many errors are detected in the multiframe alignment signal (MAS) (same conditions as for loss of frame alignment). The loss of multiframe alignment is reported by means of the Y bit (see *Figure A-1*).
- **Alarm indication signal (AIS).** The AIS signal is an unframed "all-ones" signal, and is used to maintain line signal synchronization in case of loss of input signal, e.g., because an alarm condition occurred in the equipment that supplies the line signal.

Note *The equipment receiving an AIS signal loses frame synchronization.*

C.2 IP Environment

This section describes the IP environment, to provide background information for configuring the parameters that control the routing of management traffic.

The information presented in this section refers to Version 4 of the IP protocol (IP4), currently the most widely used protocol version.

Introduction to IP

IP means "Internet Protocol". The term ***IP protocol*** is often used to indicate a standardized set of rules and procedures that enable data exchange through a packet-switched network.

Accordingly, the term ***Internet*** indicates the set of networks that use the IP protocol and are interconnected in a way that, at least in principle, permits any entity on one network to communicate with any entity on another network.

Note *The term "suite of IP protocols" is also often used, in recognition of the fact that the operation of the Internet is actually defined by many related protocols.*

IP Networks, IP Hosts and IP Ports

Any entity that can communicate using the IP protocol is called an ***IP host***.

The connection point between an IP host and an IP network is called ***IP port***.

An ***IP network*** forms when a number of IP ports can communicate directly (peer to peer) using the IP protocol, without any intermediaries.

An IP host can have any number of IP ports. Moreover, the ports may be located on different IP networks.

IP Addresses

To enable IP communication between two IP hosts, it is necessary to find a route between their IP ports. For this purpose, each IP port is assigned an IP address.

An IP address is a number selected in accordance with the IP protocol. The only purpose of an IP address is to permit unambiguous identification of an IP port. Therefore, each IP port must be assigned a distinct and unique IP address.

The IP protocol does not require the IP port to be related in an unambiguous way to a physical (communication) port. This has two main implications:

- Since the IP port is actually a connection to an IP network, any number of IP ports can share a given physical port.
- An IP port may be reached through several physical ports.

Note *By convention, the scope of IP addresses has been extended in two ways:*

- *To permit identification of IP networks*
- *To permit simultaneous addressing of all the ports connected to a IP network (this operation is called broadcasting).*

IP Packet Structure

The information exchanged through IP networks is organized in packets. The structure of an IP packet, as specified by IP protocol Version 4, is shown in *Figure A-2* (the numbers are byte numbers):

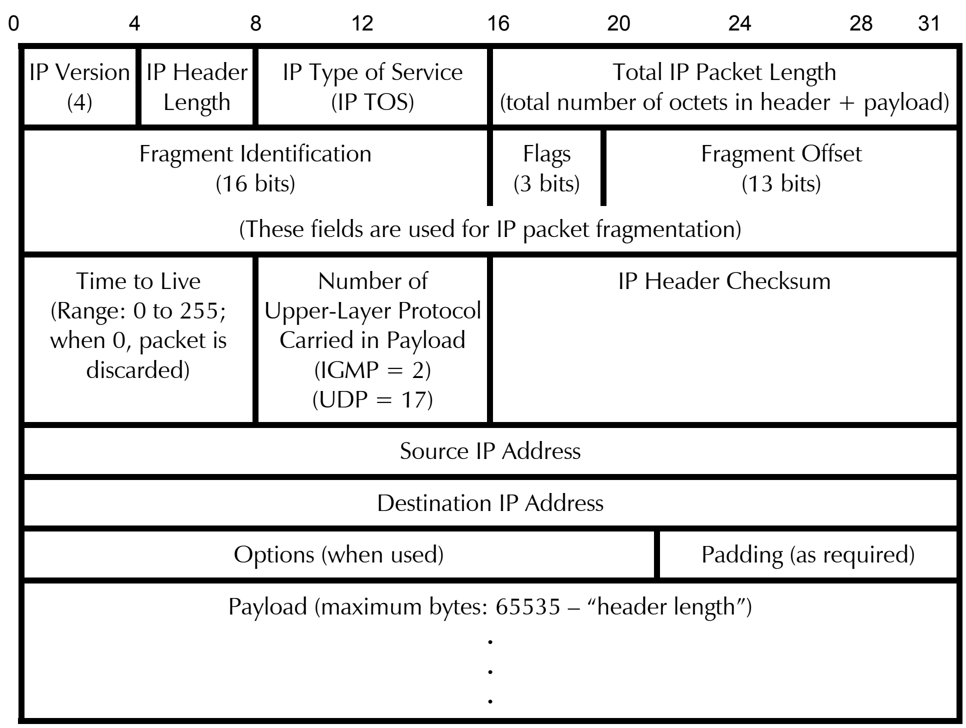


Figure C-2. IP Packet Structure

IP Address Structure

An IP address is a 32-bit number, represented as four 8-bit bytes. Each byte represents a decimal number in the range of 0 through 255.

The address is written in decimal format, with the bytes separated by decimal points, e.g., 164.90.70.47. This format is called *dotted quad notation*.

An IP address is logically divided into two main portions:

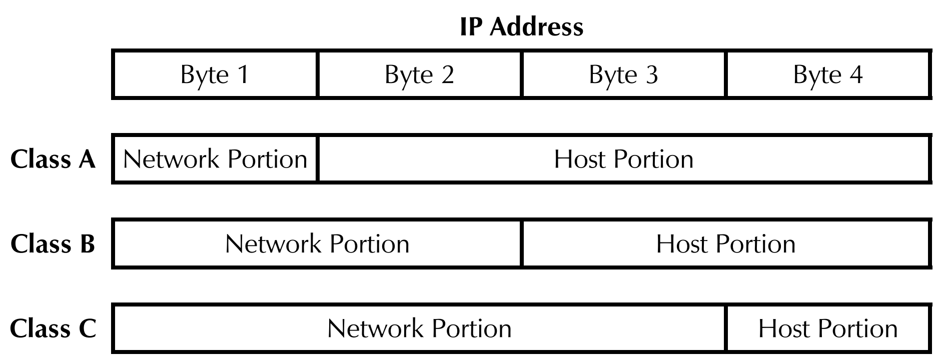
- Network portion
- Host portion.

Network Portion

In general, the network portion is assigned by the Internet Assigned Numbers Authority (IANA), and its main purpose is to identify a specific IP network. For exceptions, see the *Global vs. Private IP Addresses* section below.

There are five IP address classes: A, B, C, D, and E. However, only the A, B and C classes are used for IP addressing. Consult your network manager with respect to the class of IP addresses used on your network.

The network portion of an IP address can be one, two, or three bytes long, in accordance with the IP address class. This arrangement is illustrated below:



The class of each IP address can be determined from its leftmost byte, in accordance with the following chart:

Address Class	First Byte	Address Range
Class A	0 through 127	0.H.H.H through 127.H.H.H
Class B	128 through 191	128.N.H.H through 191.N.H.H
Class C	192 through 223	192.N.N.H through 223.N.N.H

where:

N – indicates bytes that are part of the network portion
H – indicates bytes that are part of the host portion.

Host Portion

In general, the host portion is used to identify an individual host connected to an IP network. For exceptions, see *Subnetting* section below.

After obtaining an IP network address, the using organization is free to assign host identifiers in accordance with its specific needs.

Note *The following host identifiers have special meanings, and must not be assigned to an actual host:*

- *The "all-zeros" host identifier is interpreted as a network identifier.*
- *The "all-ones" host identifier is interpreted as a broadcast address. Therefore, a message with an "all-ones" host identifier is accepted by all the hosts in the network.*

Global vs. Private IP Addresses

Given the current number of users already having access to the Internet, and the rapid increase in this number, the 32-bit IP space address available in Version 4 of the IP protocol is rather limited.

On the other hand, an IP address must permit unambiguous identification of any host in the Internet. That is the reason the allocation of IP addresses to networks is globally controlled by a universally-accepted IP registry organization (IANA).

Although any address used on the Internet must be unique, there are many IP networks, called private networks, which are not connected to the Internet. A private network is also created when the access of hosts to the Internet is controlled by protocols and procedures that do not permit an outsider to find and use directly the actual address of the hosts connected to that network. A typical example of a private network is the internal IP network of an enterprise (such networks are often called ***intranets***).

In recognition of this fact, IANA permits using two types of addresses:

- Global addresses, i.e., addresses that and are unique in the whole Internet
- Private addresses, i.e., addresses allocated for internal use only and therefore cannot be used on the Internet.

  Although no restrictions need to be imposed on private addresses except for conforming to the structure specified in the *Network Portion* section above, the following address spaces have been specifically put aside by IANA for use as private addresses:

  - The Class A addresses in the range of 10.0.0.0 to 10.255.255.255 (this group of addresses is formally referred to as 10/8). This address space is actually one Class A network number.
  - The Class B addresses in the range of 172.16.0.0 to 172.31.255.255 (this group of addresses is formally referred to as 172.16/12). This address space defines 16 contiguous Class B network numbers.
  - The Class C addresses in the range of 192.168.0.0 to 192.168.255.255 (this group of addresses is formally referred to as 192.168/16). This address space defines 256 contiguous Class C network numbers.

Subnetting

Given the scarcity of IP network addresses, for organizations operating several relatively small, physically separated, IP networks, e.g., several departmental networks, it is advantageous to enable several physical networks to share a common IP network address. *Small* in this context means that the number of IP ports connected to each of these networks is small relative to the host address space for the corresponding IP address class.

The approach taken to enable the sharing of an IP network address by two or more networks is called *subnetting*, which means *use of subnets*. The subnetting is relevant only within the using organization, and therefore can be freely selected to meet its specific needs.

To enable subnetting, the meaning of the bits in the host portion of the IP address is further sub-divided into two portions:

- Subnet number. For example, subnet numbers can be used to identify departmental subnets. The subnet number follows the network identifier.
- Host number – the last bits of the IP address.

This subdivision is illustrated below:

Net Number	Subnet Number	Host Number

For example, when the subnet includes 16 IP hosts, only the last four bits need to be reserved for the host number. For an organization which obtained one global Class C network address, this means that four bits are available to identify subnets. Therefore, this organization can implement 16 IP subnets, each comprising up to 16 hosts (except for two subnets that are limited to 15 hosts).

Subnet Masks

Subnet masks are used to indicate the division of the IP address bits between the net and subnet portion and the host portion.

The mask is a 32-bit word that includes "*ones*" in the positions used for net and subnet identification, followed by "*zeros*" up to the end of the IP address.

For example, the default subnet mask for any Class C address (i.e., all the eight bits in the host address space are used for hosts in the same net) is 255.255.255.000.

However, if the same address is used in a subnet comprising up to 16 hosts and for which the host numbers range is 00 to 15, the subnet mask changes as follows:

IP Address (Dotted-Quad)	192	70	55	13
IP Address (Binary)	1011 1111	0100 0110	0011 0111	0000 0111
Subnet Mask (Binary)	1111 1111	1111 1111	1111 1111	1111 0000
Subnet Mask (Dotted-Quad)	255	255	255	240

In most applications, the binary subnet mask is built as a contiguous string of "*ones*", followed by a number of "*zeros*" (the number of "*zeros*" is selected as needed, to complete the number of subnet mask bits to 32). Therefore, when this conventional approach is used, the subnet mask can also be specified simply by stating the number of "*ones*" in the mask. For example, the subnet mask shown above is specified by stating that it comprises 28 bits.

IP Routing Principles

The exchange of information between IP hosts is made in packets using the structure specified by the IP protocol. As explained in the *IP Packet Structure* section above, IP frames carry, within their header, the IP addresses of the destination and source hosts.

In accordance with the IP protocol, an IP host checks the addresses of all the received frames, and accepts only frames carrying its own IP address as the destination.

The source address is then used to enable the destination to respond to the source.

An IP host will also respond to broadcasts (frames whose destination host identifier is "*all-ones*").

Note *IP hosts support additional protocols within the IP suite, e.g., protocols used for connectivity checking, maintenance, etc. Therefore, IP hosts will accept additional types of messages, which are beyond the scope of this description.*

When checking the destination address of an IP frame, an IP host starts by checking the network identifier. If the network identifier is different, the host will immediately reject the frame. Therefore, IP hosts can communicate only if they have the same network identifier.

For example, this means that when a management station managing the FCD-E1LC is connected directly, through a LAN, to the FCD-E1LC Ethernet management port, the network identifier part of the IP address assigned to the FCD-E1LC Ethernet port must be identical to the network identifier of the management station.

To enable hosts located on different IP networks to communicate, IP routers are needed. Each router monitors the flowing IP traffic and identifies the IP addresses of the local hosts connected to them, and then communicates this information to all the other routers, using a special protocol (the Routing Internet Protocol, RIP). Therefore, a router can determine to which other router to send a packet with a foreign IP address.

Note *RAD agents, for example, the management agent of the FCD-E1LC, also use a RAD proprietary routing protocol, similar to RIP, for handling RAD management traffic.*

The user can increase the routing efficiency by specifying a default gateway to handle IP traffic to other networks (this is always an IP router). When a default gateway address is specified, packets with IP destinations located on other

networks are sent to the default gateway for processing: the router serving as default gateway then sends them to their destination.

The default gateway must always be in the same IP subnet as the port sending traffic to the gateway.

C.3 Ethernet Transmission Technology

Introduction to Ethernet Transmission

The basic standard covering Ethernet LANs is IEEE Standard 802.3, which is very similar to the original Ethernet V2.0 specification (ISO/IEC also have a similar standard). In addition to the aspects covered by IEEE 802.3 standards, there is a wide range of LAN standards (the IEEE 802 family) that cover other aspects of LAN transmission, for example, bridging, with particular emphasis on Ethernet LANs.

Ethernet standards (in their broadest interpretation) cover the physical and data link control layers (layers 1 and 2 in the OSI model; IP is a layer 3 protocol). The data link control layer is split into two sublayers: media access control (MAC) and logical link control (LLC).

Ethernet LAN Topologies

Figure A-3 shows the general structure of a LAN using the star topology, which today is the most widely used topology.

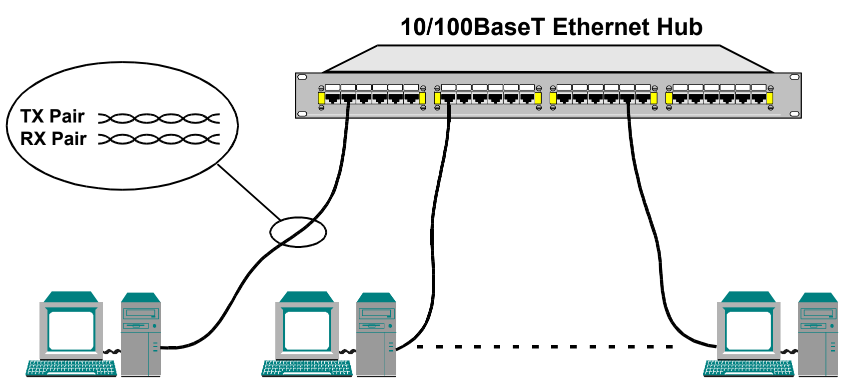


Figure C-3. Star (Hub-Based) Ethernet LAN Topology

In the star topology, all the nodes on the LAN are connected to a common unit, which serves as the hub of the LAN. The hub can be implemented in two ways:

- Simple Ethernet hub, which detects the transmitting node and transparently distributes its signal to all the other nodes. A hub supports only half-duplex communication (the same as in a bus topology).
- Ethernet switch: the switch includes more sophisticated circuits that support both half-duplex and full-duplex operation and prevent collisions.

In a star topology, the LAN cables are usually made of two twisted pairs (one transmit pair and one receive pair). The standard connector type is RJ-45, and its

pin assignment has also been standardized. However, because of the need to use separate transmit and receive pairs, two types of port pin assignments have developed: station ports and hub ports (the difference is that the transmit and receive pins in the connector have been interchanged).

This permits to interconnect connectors of different types by a cable wired pin-to-pin (straight cable). However, when it is necessary to interconnect ports of same type, a crossed cable (a cable wired to interconnect the transmit pair at one end to the receive pair at the other end) must be used (see other alternatives on page *C-13*).

Interfaces operating on twisted pairs are designated in accordance with data rate: 10Base-T (10 Mbps) or 100Base-TX (100 Mbps, where X is the number of pairs). Interfaces that support both rates are identified as 10/100BaseT.

Ethernet Communication Protocol

Today, Ethernet is used as a generic term for a LAN transmission technology that uses Carrier Sense and Multiple Access with Collision Detection (CSMA/CD) to enable the transmission of short bursts of data (called *frames*) between two or more stations (*nodes*). The simplest way to visualize the transmission technology is to use a bus analogy, where the bus runs between all the users.

Therefore, all the users have permanent access to the full bandwidth of the transmission medium but can only use it for short times, by transmitting short data bursts. Each data burst has a fixed structure, called a frame. The frame structure is explained below. The connection point of each user to the transmission media is called a node. For identification purposes, each LAN node is assigned a unique number, called address.

Media Access Method

Media access is performed by means of the carrier sense, multiple access protocol (CSMA) with collision detection (CD), defined by IEEE Standard 802.3. The protocol defines three basic steps:

- A node that wants to transmit checks that the LAN is free. If another node is already transmitting, the node waits until the LAN is free.
- When the LAN is free, the node starts transmission and sends its frame. Each node has equal access rights, therefore the first node that starts transmitting is the one that seizes the LAN.
- When two nodes start transmitting at the same instant, a collision occurs. In this case, the transmitting nodes will continue to transmit for some time, in order to ensure that all transmitting nodes detected the collision (this is called "jamming"). After the jamming period, all transmitting nodes stop the transmission and wait for a random period of time before trying again.

  The delay times are a function of collision numbers and random time delay, therefore there is a good chance that an additional collision between these nodes will be avoided, and the nodes will be able to transmit their messages.

The basic procedure described above has been developed for half-duplex communication, because it declares a collision whenever data is received during a local transmission. However, when using twisted pairs, separate pairs are used

for the transmit and receive directions. Therefore, each node is capable of simultaneously transmitting and receiving (full-duplex operation), thereby doubling the effective data rate on the LAN.

Most Ethernet interfaces are capable of operation at the two basic rates, 10 Mbps and 100 Mbps (such interfaces are designated 10/100BaseT). Therefore, four operating modes are possible.

These modes are listed below in ascending order of capabilities:

- Half-duplex operation at 10 Mbps.
- Full-duplex operation at 10 Mbps.
- Half-duplex operation at 100 Mbps.
- Full-duplex operation at 100 Mbps.

Autonegotiation

To ensure interoperability (which practically means to select the highest transport capability supported by all the equipment connected to the LAN), two approaches can be used: manual configuration of each equipment interface, or automatic negotiation (auto-negotiation) in accordance with IEEE Standard 802.3.

The auto-negotiation procedure enables automatic selection of the operating mode on a LAN, and also enables equipment connecting to an operating LAN to automatically adopt the LAN operating mode (if it is capable of supporting that mode).

When auto-negotiation is enabled on all the nodes attached (or trying to attach) to a LAN, the process is always successful. However, even if the nodes on an operating LAN are manually configured for operation in a fixed mode, a late-comer node with auto-negotiation capability can still resolve the LAN operating rate can be resolved, thereby enabling it to adopt the LAN rate. Under these conditions, an auto-negotiating node cannot detect the operating mode (half or full duplex), and therefore they will default to half-duplex. Therefore, as a practical configuration rule, the full-duplex mode should not be enabled without enabling auto-negotiation, except when all the nodes have been manually configured for the desired operating mode (which may of course be full duplex).

The standard protocol that permits intelligent 10/100BaseT Ethernet ports to automatically select the mode providing the highest possible traffic handling capability also provides the following additional capabilities:

- Automatic detection and correction of MDI/MDIX crossover and polarity, which enables connecting the FCD-E1LC Ethernet port to any other port (station or hub) by any type of cable (straight or cross-wired)
- Use of 802.3 flow control in the full-duplex mode and backpressure flow control in the half-duplex mode.

Basic Ethernet Frame Structure

The frame transmitted by each node contains routing, management and error correction information. For Ethernet LANs, the characteristics of frames are defined by IEEE Standard 802.3.

Basic frame lengths can vary from 72 to 1526 bytes and have the typical structure shown in *Figure A-4*.

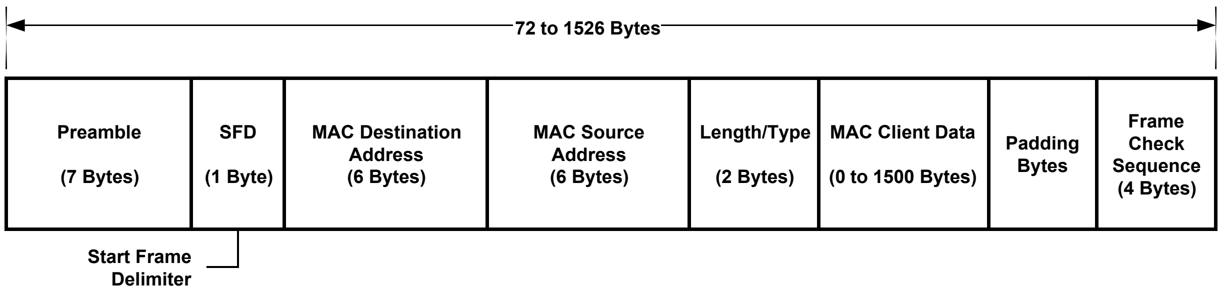


Figure C-4. Basic Ethernet Frame Structure

- Preamble. Each frame starts with a preamble of seven bytes. The preamble is used as a synchronizing sequence for the interface circuits, and helps bit decoding.
- Start-Frame Delimiter (SFD) field – consists of one byte. The SFD field indicates where the useful information starts.
- Medium-Access (MAC) Destination Address (DA) field – consists of six bytes. The MAC DA field carries the address of the destination node.
- Medium-Access (MAC) Source Address (SA) field – consists of six bytes. The MAC SA field carries the address of the source node.

Note *In writing, MAC addresses are represented as 6 pairs of hexadecimal digits, separated by dashes, for example, 08-10-39-03-2F-C3.*

- Length/Type field – consists of two bytes that indicate the number of bytes contained in the logical link control (LLC) data field. In most Ethernet protocol versions, this field contains a constant indicating the protocol type (in this case, this field is designated EtherType).
- MAC Client Data field. The MAC client data field can contain 0 to 1500 bytes of user-supplied data.
- Padding field. The optional padding field contains dummy data, that is used to increase the length of short frames to at least 64 bytes.
- Frame Check Sequence (FCS) field – contains four check bytes generated by a cyclic redundancy check (CRC) code. The FCS field is used to detect errors in the data carried in the frame.

Bridging

Communication between Nodes on Same LAN

Unlike IP addresses, a MAC address is unique and identifies a single physical port. Therefore, two Ethernet nodes attached to the same LAN exchange frame directly, by specifying the desired MAC destination address, together with the source MAC address. The node that identifies its MAC address in the destination field can send a response by copying the source address of the frame to the destination address field.

Communication between Nodes on Different LANs

To enable nodes on different LANs to communicate, it is necessary to transfer frames between the two LANs. The device used for this purpose is called ***MAC bridge***, or just ***bridge***. Two types of bridges are used:

- Local bridges, which have Ethernet ports attached to the two LANs. The bridge control mechanism learns the nodes attached to each LAN by reading the source MAC addresses of the frames generated by the nodes. When the destination address of a frame is not on the LAN from which it was received, the bridge transfers it to the other LAN.
- Remote bridges, which are used in pairs. A basic remote bridge has one LAN port and one WAN port. The WAN port communicates through a link with the WAN port of the remote bridge connected to the desired remote LAN. In this case, the traffic addressed to destinations not located on the local LAN is transferred through the WAN link to the remote bridge.

Using Virtual Bridged LANs

VLAN can be used to provide separation between traffic from different sources sharing the same physical transmission facilities, and provide information on the relative priority the user assigns to each frame. The characteristics and use of virtual LANs (VLANs) and of the MAC bridges capable of handling tagged frames are defined in IEEE Standard 802.1Q.

VLANs are made possible by a slight modification to the Ethernet frame structure shown in *Figure A-4.*

The structure of an Ethernet frame with VLAN support is shown in *Figure A-5* (for simplicity, the figure does not include the preamble and SFD fields).

0 4 8 12 16 20 24 28 31

<table>
<tr><td colspan="4">Destination MAC Address (DA)</td></tr>
<tr><td>Destination MAC Address (DA)</td><td colspan="3">Source MAC Address (SA)</td></tr>
<tr><td colspan="4">Source MAC Address (SA)</td></tr>
<tr><td>Tag Protocol Identifier (8100)</td><td>PRI</td><td>0</td><td>VLAN ID</td></tr>
<tr><td>EtherType (IP = 0800)</td><td colspan="3">Ethernet Payload (42 to 1500 Bytes)</td></tr>
<tr><td colspan="4">Ethernet Payload
⋮</td></tr>
<tr><td colspan="4">CRC</td></tr>
</table>

Figure C-5. Structure of Ethernet Frame with VLAN Support

Ethernet frames with VLAN support include a tag header immediately after the source MAC address (therefore, such frames are also referred to as ***tagged frames***).

The tag header comprises 4 bytes:

- Two bytes for the tag protocol identifier. For Ethernet-encoded tags in accordance with IEEE802.1Q, these bytes carry the equivalent of 8100.
- Priority (PRI) specified by the user (3 bits: 7 is the highest priority and 0 is the lowest priority). The priority field enables the user to instruct the network to handle high-priority frames preferentially, for example, to reduce the delay or minimize the chances for loss of frames in case of congestion.

Note *The ToS field included in the IP packet headers (see Figure A-2) can also be used to ensure preferential handling of certain types of packets.*

- One bit for the canonical format indicator (always 0 as shown in *Figure A-5*).
- VLAN ID (12 bits), used to indicate the VLAN to which the frame belongs.

Transporting IP Traffic over Ethernet

Encapsulation in Ethernet Frames

IP traffic is carried in the LLC data field of the Ethernet frame (see *Figure A-4*). This is called ***encapsulation***. The EtherType value for the IP protocol is 0800.

Whenever possible, the whole IP packet (including the header) is inserted in one Ethernet frame. However, IP packets can be much longer than the LLC data field of Ethernet frames: in this case, it is necessary to fragment the IP packets in accordance with the desired size of data field, and transfer each fragment in a separate frame. The receiving IP host then reassembles the original packet from its fragments.

ARP Protocol

When sending IP packets over Ethernet, it is necessary to determine the MAC address of the destination, to insert it in the Ethernet destination MAC address of the packet. Actually, this is necessary for any physical transmission technology which is not limited to point-to-point topologies.

This is performed by means of the ARP (Address Resolution Protocol), part of the IP suite of protocols. ARP is used to generate a look-up table that translates IP addresses to MAC addresses for any transmission technology. The translation is done only for outgoing IP packets, because this is when the IP header and the Ethernet header are created.

The ARP table contains one row for each IP host: each row has two columns, one listing the IP address and the other listing the corresponding MAC (Ethernet) address. When translating an IP address to an Ethernet address, the table is searched for the row corresponding to the destination IP address, and the corresponding Ethernet address is then found in the same row.

Whenever a packet must be sent to a new IP destination, that is, a destination whose MAC address is not known, the IP host sends an ARP request packet, listing its own IP address and MAC address, the destination IP address, but no destination MAC address. When the packet reaches the destination address (using the IP routing process), the destination returns an ARP response packet, in which its own MAC address field is filled. The packet eventually returns to the sender, thereby providing the missing information.

Appendix D

Supervision Terminal Commands

D.1 Introduction

This appendix provides a detailed description of the FCD-E1LC supervision language. The information appearing in this appendix assumes that the user is familiar with the FCD-E1LC system and with its configuration parameters. If necessary, review *Appendix C* for a description of the FCD-E1LC operating environment, *Chapter 3* for a general description of the FCD-E1LC supervision language syntax, and *Chapter 1* for a functional description of the FCD-E1LC.

The commands described in this section are listed in alphabetical order (see the *Command Set Index* table in *Chapter 3* for a complete list). The description includes the command format, usage, and options.

The following notational conventions are used:

[ ]	square brackets indicate optional entry/parameter.
{ }	accolades indicate required entry/parameter.
' '	single quotes delimit user entry.
<Enter>	indicates the pressing of the Enter key.
<SP>	indicates the pressing of the spacebar.
CC	indicates the data channel number, 1 or 2.

Note

The screens appearing in this appendix are given for illustration purposes only, and must not be construed as providing typical parameter values. Parameter values must be selected in accordance with the specific requirements of each particular application. If necessary, contact RAD Technical Support Department.

D.2 Commands

BYE

Purpose

End the current Telnet session.

Syntax & Use

To end the current Telnet session, type:

```
BYE<Enter>
```

CLR ALM

Purpose

Clear all the alarms stored in the alarm buffer (including ON/OFF alarms).

Syntax & Use

To clear all the alarms, type:

```
CLR ALM/A<Enter>
```

CLR LOOP

Purpose

Deactivate the specified user-initiated test or loopback.

Note *The FCD-E1LC rear-panel E1/T1 LOOPBACK switch can also be used to deactivate the following loopbacks:*

- *Main link local analog loopback*
- *Main link remote analog loopback*
- *Sublink local analog loopback*
- *Sublink remote analog loopback.*

The functions of this switch are described in Chapter 2. To deactivate a loopback, the corresponding switch section must be returned to OFF (if necessary, first set it to ON, and then back to OFF).

Syntax

CLR LOOP

Use

1. To deactivate all the main link loopbacks and tests, type:

   CLR LOOP ML<Enter> or CLR LP ML<Enter>

   To deactivate a specific main link loopback or test, type:

   CLR LOOP LOC ANA ML<Enter> or **CLR LP LOC ANA ML<Enter>**
   CLR LOOP REM ANA ML<Enter> or **CLR LP REM ANA ML<Enter>**
   CLR LOOP LOC DIG ML<Enter> or **CLR LP LOC DIG ML<Enter>**
   CLR LOOP REM DIG ML<Enter> or **CLR LP REM DIG ML<Enter>**
   CLR LOOP BERT ML<Enter> or **CLR LP BERT ML<Enter>**
   CLR LOOP INBAND ML<Enter> or **CLR LP INBAND ML<Enter>**

2. To deactivate all the sublink loopbacks and tests, type:

   CLR LOOP SL<Enter> or CLR LP SL<Enter>

   To deactivate a specific sublink loopback or test, type:

   CLR LOOP LOC ANA SL<Enter> or **CLR LP LOC ANA SL<Enter>**
   CLR LOOP REM ANA SL<Enter> or **CLR LP REM ANA SL<Enter>**
   CLR LOOP LOC DIG SL<Enter> or **CLR LP LOC DIG SL<Enter>**
   CLR LOOP REM DIG SL<Enter> or **CLR LP REM DIG SL<Enter>**

3. To deactivate a data channel loopback, type:

   CLR LOOP LOC CH 1<Enter> or **CLR LP LOC CH 1<Enter>**
   CLR LOOP LOC CH 2<Enter> or **CLR LP LOC CH 2<Enter>**
   CLR LOOP REM CH 1<Enter> or **CLR LP REM CH 1<Enter>**
   CLR LOOP REM CH 2<Enter> or **CLR LP REM CH 2<Enter>**

Note *The deactivation of an inband loopback is made by repeatedly transmitting the deactivation sequence, therefore the loopback can be considered as deactivated only after approximately 2 seconds.*

If no user-initiated loopback of the specified type is now performed, you will receive

ERROR 052: LOOP IS NOT ACTIVE.

DATE

Purpose

Set the date for the FCD-E1LC internal real-time clock.

The internal clock supports dates up to December 31st, 2099.

Syntax

DATE

Use

1. To set the date, type:

   `DATE<Enter>`

   FCD-E1LC displays the date entry form:

   ```
   DAY        = 06
   MONTH      = 02
   YEAR       = 2004
   ```

4. Change by pressing ‹F› to increase and ‹B› to decrease the displayed values. When done, press ‹Enter› to move to the next field.
5. To end, press ‹Enter› after the YEAR field.

DEF AGENT

Purpose

Display and modify the current SNMP agent parameters.

This command is used to configure the parameters needed to enable SNMP and Telnet management.

Refer to *Appendix B and Appendix C* for background information.

Syntax

DEF AGENT

Use

1. To define the SNMP agent parameters, type:

   `DEF AGENT<Enter>`

   You will see the current agent parameters under the header **`OLD AGENT PARAMETERS`**, followed by the entry row for the first parameter, **`TELNET_APATHY_TIME`**.

2. Select the desired value by pressing ‹F› or ‹B›, then press <Enter> to display the second row. Continue until all the parameters are defined, and then press <Enter> to continue.
3. Once the next parameter is displayed, type in the new value, and then press <Enter> to end.

A typical display, as seen after all the parameters are selected, is shown below:

```
Telnet_APATHY_TIME
10 MIN
IP_ADDRESS IS            :  = 192.114.029.209
READ COMMUNITY IS        :  = public
WRITE COMMUNITY IS       :  = private
TRAP COMMUNITY IS        :  = public
```

Table D-1 lists the agent parameters, along with their range of values and instructions on how to modify them.

Table D-1. SNMP Agent Parameters

Parameter	Function	Values
TELNET_APATHY_TIME	Selects the time, in minutes, after which a Telnet connection will be automatically terminated if no incoming activity is detected	The available values are 10MIN, 15MIN, and 20MIN. Default: 10MIN
IP_ADDRESS	Type in the IP address assigned to the FCD-E1LC SNMP agent	Use the dotted-quad format (four groups of digits in the range of 0 through 255, separated by periods). Default: 999.999.999.999
SNMP READ COMMUNITY	Type in the name of the SNMP community that has read-only authorization (the FCD-E1LC SNMP agent will accept only **getRequest** and **getNextRequest** commands from management stations using that community)	Up to eight alphanumeric characters. Default: public
SNMP WRITE COMMUNITY	Type in the name of the SNMP community that has read-write authorization (the FCD-E1LC SNMP agent will also accept **setRequest** commands from management stations using that community)	Up to eight alphanumeric characters. Default: private
TRAP COMMUNITY	Type in the name of the SNMP community to which the FCD-E1LC SNMP agent will send traps	Up to eight alphanumeric characters Default: public

DEF ALM MASK

Purpose

Display and modify the alarm masks (masked alarms are not reported).

The alarm masks are used to disable the reporting of alarms by unused ports, and stop the generation of alarms during maintenance.

Syntax

DEF ALM MASK

Use

1. To display the alarm mask data form, type:

   DEF ALM MASK<Enter>

2. You will see the first row, used to select the group of alarms to be processed. A typical display is shown below:

```
GROUP      ALL
SYSTEM     USER
```

The functions of the fields are as follows:

GROUP — Selects the group of alarms to be processed:

SYSTEM	System alarms
ML	Main link alarms
SL	Sublink alarms
CH1	Data channel 1 alarms
CH2	Data channel 2 or Ethernet port alarms.

ALL — Enables the masking of all alarms:

MASK	All the alarms of a specific group are masked.
USER	You can define the individual alarms to be masked.
NORMAL	None of the alarms in the specific group is masked.

3. Move the cursor to the desired field using the spacebar, and then change using the ‹F› or ‹B› keys.

   - If you select MASK or NORMAL for ALL, press ‹Enter› to end.
   - If you select USER, select the desired group of alarms, and then press ‹Enter› to display the group of alarms to be processed. A typical display is shown below:

```
ALARM NUMBER & DESCRIPTION          MASKED
04 ALARM BUFFER OVERFLOW            NO
```

   The functions of the fields are as follows:

   ALARM NUMBER — Displays the first alarm number (code and description) in the selected group (see *Chapter 4*).

   MASKED — Enables the masking of the selected alarm:

YES	The alarm is masked.
NO	The alarm is not masked, and will be reported when generated.

4. Select the desired state for the current alarm by pressing the ‹F› or ‹B› key, and then press ‹Enter› to display the next alarm number. Repeat the

procedure until all the alarms in the selected group have been defined. After the last alarm, you will see again the date and time, followed by the working prompt.

DEF AR

Purpose

Control the use of SNMP traps for alarms reporting.

Syntax

DEF AR

Use

1. To configuration the use of traps for alarm reporting, type:

   DEF AR<Enter>

   FCD-E1LC displays the alarm data form.

```
ALARM         REPORT
MAJOR ON      NO
```

2. To display the next row, press <Enter>. A typical data form, as seen after all the rows have been displayed, is shown below:

```
ALARM         REPORT
MAJOR ON      YES
MAJOR OFF     YES
MINOR ON      YES
MINOR OFF     YES
```

   The data form lists the relevant alarm conditions, and the action to be taken for each alarm condition. The following fields appear on the data form:

   ALARM The reported condition:

   MAJOR ON A new major alarm condition has been detected.

   MAJOR OFF The major alarm condition disappears.

   MINOR ON A new minor alarm condition has been detected.

   MINOR OFF The minor alarm condition disappears.

   REPORT The response to the corresponding condition:

   YES – the corresponding alarm condition is reported by means of a trap sent to management stations.

   NO – the corresponding alarm does not result in a trap.

3. To change the current selections, bring the cursor to the desired field, and then press the <F> or <B> keys to display the desired selection (YES or NO). When done, press <Enter> to end.

DEF BERT ML

Purpose

Define the BERT test conditions. Refer to *Table D-2* for the parameter description, allowable ranges and configuration guidelines.

Syntax

DEF BERT

Use

1. To define the BER test parameters, type:

   DEF BERT ML<Enter>

   The first row of the BERT parameters data form is displayed:

PATTERN	ERROR_INJECTION_RATE	RX_INBAND	INBAND_LOOP_PATTERN	BERT_MODE
2E23-1	NO_ERR	DISABLE	USER CONFIG	USER

2. If you choose USER CONFIG, the second row of the data form is displayed:

USER_PATTERN_LEN	USER_ACTIVATE_PAT
1	XXXXXXX0

3. Select the length of the user-selected. After pressing <Spacebar>, the cursor moves to the first place in the USER_ACTIVATE_PAT field, which contains a template used to specify the activation pattern. The template enables changing the selected number of binary places (these are always the last places). Move the cursor (by pressing <Spacebar>) to each desired position and set the corresponding digit in the template to 0 or 1 by pressing <F> or <B>.
4. When done, press <Enter> to display the third row of the data form.

USER_PATTERN_LEN	USER_DEACTIVATE_PAT
1	XXXXXXX0

5. Select the user deactivation pattern using the procedure of *Step 3*.
6. After making the required selections, press <Enter> to end.

Table D-2. BERT Configuration Parameters

Parameter	Function	Values
PATTERN	Selects the test pattern for the data channel	The available selections are the QRSS test pattern and the following pseudo-random sequences: 511, 2047, 2E15-1, 2E23-1. Default: 2E23-1
ERROR_INJECTION_RATE	Enables the injection of a calibrated rate in the transmitted test pattern	NO ERR – Disables the injection of errors. SINGLE – Injects a single error when <I> is pressed (see DSP BERT command). 10E-1 – Error injection at a rate of 10^{-1}. Default: NO ERR

Parameter	Function	Values
RX_INBAND	Enables the activation of a main link remote digital loopback in response to the reception of the inband loopback code from the remote system	ENABLE – Inband loopback command accepted. DISABLE – Inband loopback command ignored. Default: DISABLE
INBAND_LOOP_ PATTERN	Selects the type of loopback activation and deactivation sequences	RDL LOOP – Use of the FT1/FE1 RDL sequence in accordance with T1.403. USER CONFIG – Use of user-defined patterns. Default: RDL LOOP
BERT_MODE	Selects the main link timeslots in which the BER test will be performed	CH1 – The BER test will be made in the timeslots assigned to data channel 1. CH2 – The BER test will be made in the timeslots assigned to data channel 2. S1 – The BER test will be made in the timeslots assigned to the sublink. USER – The BER test will be made in the timeslots selected by the user. Default: CH1
USER_PATTERN_LEN	Defines the length of the user-defined activation or deactivation sequence. This field is displayed only when INBAND_LOOP_PATTERN is USER CONFIG	The allowed range is 1 to 8. **Default: 1**
USER_ACTIVATE_PAT	Used to specify a loopback activation pattern. This field is displayed only when INBAND_LOOP_PATTERN is USER CONFIG	Select 1 or 0 for each changeable place in the template. Default: 0
USER_DEACTIVATE_ PAT	Used to specify a loopback deactivation pattern. This field is displayed only when INBAND_LOOP_PATTERN is USER CONFIG	Select 1 or 0 for each changeable place in the template. Default: 0

If the BERT_Mode parameter is USER, then after pressing <Enter> to end the selection of the loopback deactivation pattern you will see the first row of the timeslot selection map. A typical display is shown:

```
TS 01   TS 02   TS 03   TS 04   TS 05   TS 06   TS 07
NO      NO      NO      NO      NO      NO      NO
```

Use the following procedure to select the required timeslots:

- Move the cursor to the desired timeslot field by pressing the spacebar.
- To enable BER testing in this timeslot, type <F> or <B> to change the selection to YES.

  The default, NO, means that the timeslot can continue to carry payload while a BER test is performed.
- After making the selections in the first line, press <Enter> to continue to the second line (timeslots 8 to 14).
- Repeat the operations until the last line, ending in timeslot 31, is completed.

DEF CALL

Purpose

Define the call-out parameters for the FCD-E1LC dial-out function.

The specified call-out parameters are used by FCD-E1LC to build the call command that is sent to the dial-out modem. The modem connected to the CONTROL DCE connector must be set up as follows (for convenience, the Hayes commands required to select the specified parameters are listed in brackets):

- Auto-answer mode (**`AT S0=1`**)
- Call set up in response to the **`CONNECT`** string (**`AT X0`**)
- No echo (**`AT E0`**)
- Verbose mode (no codes, e.g., **`CONNECT`** string instead of `0`) (**`AT V1`**).

Syntax

DEF CALL

Use

1. To define the call-out parameters, type:

   ```
   DEF CALL<Enter>
   ```

   You will see the first page of the call-out parameters data form. A typical display is shown below.

```
NUM_OF_RETRIES     WAIT_FOR_CONNECT    DIAL_MODE
ALT_NUM_NUMBER
0                  30SEC               TONE         NO
```

2. Change the parameter values as follows:
   - Bring the cursor to the beginning of the first field to be changed by pressing the spacebar.
   - To change the selected field, press <F> or <B> to scroll among the available selections.

- When the desired selection is displayed, press the spacebar to move to the next field.

The call-out parameters displayed on the first page of the data form, and their range of values, are explained in *Table D-3*.

3. When done, press <Enter> to display the second page of the call-out parameters data form. A typical display is shown below.

```
NEW PRIMARY NUMBER [MAX 16 CHARS] =
```

4. Enter a new primary directory number and press <Enter>. The directory number can include up to 16 digits, including the # and the * symbols.

   FCD-E1LC displays the new primary directory number you have entered.

```
CURRENT PRIMARY DIAL COMMNAND = 'primary number'
```

5. Press <Enter>:

   If the ALT_NUM_MODE parameter is NO (no alternate number), FCD-E1LC will display the time and date, followed by the FCD-E1LC prompt.

   If the ALT_NUM_MODE parameter is YES, press <Enter> to see the third page of the call-out parameters data form, used to enter a new alternate directory number. A typical display is shown below.

```
NEW ALTERNATE NUMBER [MAX 16 CHARS] =
```

6. Enter a new alternate directory number and press <Enter>. The directory number can include up to 16 digits, including the # and the * symbols.

   FCD-E1LC displays the new alternate directory number you have entered.

```
CURRENT ALTERNATE DIAL COMMAND = 'alternate number'
```

7. After entering the desired directory number, press <Enter> to end.

Table D-3. Call-Out Parameters

Parameter	Function	Values
NUM_OF_RETRIES	This parameter is used to control the number of dialing retries. The NUM_OF_RETRIES parameter applies to both the primary and the alternate numbers: • If the call is not established after dialing the primary directory number the specified number of times, FCD-E1LC attempts to establish the call by dialing the alternate directory number (provided the use of an alternate number is enabled by means of the ALT_NUM_MODE parameter). • If the call cannot be established within the specified number of redialing attempts on neither of the two directory numbers, FCD-E1LC stops the call attempts. When a new alarm report must be sent, the call attempts are started again. The user is notified that the call attempts failed by a message recorded in the alarm buffer (separate messages are provided for each directory number).	0 – No redialing attempts are made if the call is not established on the first attempt. 1 to 8 – If the call is not established on the first attempt, FCD-E1LC will redial the specified number of times. Default: 0
WAIT_FOR_CONNECT	This parameter specifies the time FCD-E1LC will wait for an answer after each dialing attempt. If the called station does not answer within the specified time, FCD-E1LC disconnects. If additional call attempts are allowed, FCD-E1LC will redial immediately after disconnecting.	The available selections are 30, 45, or 60 seconds. Default: 30
DIAL_MODE	This parameter is used to select the dialing mode. Select the dialing mode supported by the telephone network.	TONE – The modem is instructed to use DTMF dialing. PULSE – The modem is instructed to use pulse dialing. Default: TONE
ALT_NUM_MODE	This parameter is used to control the use of an alternate number. The alternate number is dialed after the specified number of call attempts on the primary number failed.	NO – No alternate number. In this case, the FCD-E1LC stops the call attempts after the specified number of call attempts on the primary number failed. YES – The use of an alternate number is enabled. Default: NO

DEF CH

Purpose

Define the data channel parameters, and assign its timeslots on the main link.

The displayed data form depends on the channel interface – serial synchronous interface or Ethernet interface (option available only for channel 2).

Syntax

DEF CH CC

Use – Serial Data Channel

1. To define the parameters of the desired data channel, type:

   ```
   DEF CH CC<Enter>
   ```

   where CC is the number of the desired channel, 1 or 2.

   The first row of the selected channel parameters data form is displayed. A typical form is shown below.

```
MULTIPLIER    SPEED     FIFO_SIZE     CLOCK MODE     CTS
CLOCK_POLARITY
64            NC        AUTO          DCE            ON       NORMAL
```

   Refer to *Table D-4* for the parameter description, allowable ranges and configuration guidelines.

2. Change the desired parameters and then press <Enter> to display the timeslot mapping parameters row. A typical form is shown below.

```
MAP_MODE       START_TS       TS_TYPE
SEQ            1              DATA
```

3. Select the **MAP_MODE** and then press <Enter>.
4. If in Step 3 the **MAP_MODE** has been set to **SEQ:**
   - Press the spacebar to move to the **START_TS** field, and then press <F> or <B> to select the desired starting timeslot.
   - Press the spacebar to move to the **TS_TYPE** field, and then press <F> or <B> to select **DATA**.
   - Press <Enter>. The command is ended and the FCD-E1LC will display the time and date, followed by the FCD-E1LC prompt.
5. If the **MAP_MODE** has been set to **USER**, the **START_TS** and **TS_TYPE** fields are automatically set to N/A. In this case, press <Enter> to continue.

   You will see the first row of the data channel timeslot assignment map. A typical display is shown below:

```
TS   :   1    2    3    4    5    6    7    8
TYPE :   NO   NO   NO   NO   NO   NO   NO   NO
```

Use the spacebar to move between timeslots. For each timeslot, select between DATA (timeslot assigned to this data channel) and NO (not assigned) by pressing <F> or <B>.

After completing the first row, press <Enter> to continue to the next row. Repeat the procedure until all the timeslots (up to timeslot 31) are configured.

Note

- *You cannot perform mapping if the main link framing mode is* **`UNFRM`** *.*
- *Make sure to select enough timeslots to support the selected data rate are defined.*
- *The maximum number of timeslots that can be connected is 31, however when the main link framing mode is* **`G732S`**, *it is not allowed to connect to timeslot 16.*
- *If you already selected an inband management timeslot (using the DEF DNLOAD command), that timeslot type appears as* **`DEDIC`** *and cannot be changed.*

6. Pressing <Enter> after the last timeslot ends the command.

Table D-4. Serial Data Channel Configuration Parameters

Parameter	Function	Values	Configuration Guidelines
MULTIPLIER	Selects the group of rates that can be selected in the SPEED field	64 – All the selectable data rates are multiples of 64 kbps. 56 – All the selectable data rates are multiples of 56 kbps. For this selection, bit 8 of each timeslot carrying the channel data is set to "1". Default: 64	Select the data rate used by the equipment connected to the data channel. If the main link is configured for unframed operation, the data rate of *channel 1* for an FCD-E1LC with one serial data channel, or *channel 2* for an FCD-E1LC with two serial data channels, is automatically set to 2048 kbps, and its payload is routed to the main link. In this case, SPEED and MULTIPLIER parameters are not relevant.
SPEED	Indicates the channel data rate (for an Ethernet LAN interface, indicates the throughput)	Multiples of the basic rate (64 or 56 kbps, or NC (not connected)). The multiples are in the range of 1 to 31, resulting in rates of 64, 128, 192, ..., 1984 kbps or 56, 112, 168, ..., 1736 kbps, respectively. When the main link framing mode is G732S, the maximum is 30, resulting in a maximum payload rate of 1920 kbps or 1680 kbps, respectively. Default: NC	Select the data rate used by the equipment connected to the data channel. The data rate is a multiple *n*, of the basic rate. *n*, in the range of 1 through 31, actually indicates the number of main link timeslots that are needed to carry the data stream connected to the channel.

<table>
<tr><th>Parameter</th><th>Function</th><th>Values</th><th>Configuration Guidelines</th></tr>
<tr><td>FIFO_SIZE</td><td>Selects the size of the FIFO buffer used in the data channel</td><td>AUTO – Automatic size selection in accordance with the jitter that must be tolerated at each data rate.
32, 60, 104, 144 – Buffer size, in bits (corresponds to FIFO lengths of ±16, ±30, ±52 and ±72 bits).
Default: AUTO</td><td>In the DCE and DTE1 timing modes, it is not necessary to increase the FIFO size because the buffer size is automatically set by FCD-E1LC.
If the DTE2 mode is used and the jitter expected in your specific application is higher than what can be tolerated when using the automatically selected size, you can manually select a FIFO size greater than the AUTO size.</td></tr>
<tr><td>CLOCK MODE</td><td>Selects the timing mode of this user data channel.
When configuring channel 2 for an FCD-E1LC with Ethernet interface, only the DCE mode is supported, and therefore the timing clock mode cannot be changed</td><td>DCE – FCD-E1LC data port operates as a DCE and provides transmit and receive clocks to the synchronous user DTE.
DTE1 – FCD-E1LC data port supplies the receive clock to the user equipment and accepts the user transmit clock.
DTE2 – FCD-E1LC data port requires transmit and receive clocks from the user equipment.
Default: DCE</td><td>Select the timing mode in accordance with the type of equipment connected to the user data channel:
• DCE – For direct connection to a synchronous DTE.
• DTE1 – For connection via a modem with external clock or another equipment that accepts a receive clock and outputs a transmit clock.
• DTE2 – For connection via a modem or other type of equipment (such as a multiplexer), that provides both receive and transmit clocks. You must select this mode when FCD-E1LC timing is to be locked to an external clock (see CLK MASTER), or the external clock is intended for use as a fallback reference (see CLK FBACK).</td></tr>
</table>

Parameter	Function	Values	Configuration Guidelines
			Note: *The accuracy and stability of the external source clock must be compatible with system requirements, otherwise severe disruptions in network operation may occur.*
CTS	Selects the state of the CTS line in the data channel interface. When configuring channel 2 for an FCD-E1LC with Ethernet interface, this parameter is not applicable	ON – CTS line continuously on. =RTS – CTS line tracks the RTS line. Default: ON	Select in accordance with the desired operation mode of the channel. In general, you should use =RTS for operation in the polling mode. In this case, when the RTS line is OFF, the local FCD-E1LC channel continuously sends MARK in its main link timeslots. **Note:** *When the CTS line is not active (CTS=OFF), the user data interface generates an "all-ones" signal, transmitted via the main link to the far end.*
CLOCK POLARITY	Selects the polarity of the clock signal, relative to the data. When configuring channel 2 for an FCD-E1LC with Ethernet interface, this parameter is fixed at NORMAL	NORMAL – Rising edge of the clock waveform appears in the middle of the bit interval. INVERT – The falling edge of the clock waveform appears in the middle of the bit interval. Default: NORMAL	Select INVERT only when specifically instructed to do so.

Parameter	Function	Values	Configuration Guidelines
MAP MODE	Selects the timeslot assignment method used for the data channel	USER – Free user selection of timeslots. SEQ – Sequential assignment of timeslots, starting from a user-specified slot. Default: USER	Select the desired mode, in accordance with system requirements. Remember that the number of main link timeslots to be assigned must always be equal to *n*, the multiple of the basic rate that determines the channel data rate. Therefore, when you select the SEQ mode and a starting timeslot, FCD-E1LC attempts to allocate the required number, *n*, of timeslots to the channel. Timeslot 16 is automatically skipped when G732S framing is used on the main link, however all the other timeslots within the required range are automatically included. This may result in conflicts with previous assignments. Such conflicts are automatically detected and reported by error messages. In case of conflict, you may use the USER mode to assign the desired free timeslots to the data channel, until the required number of timeslot is reached. ***Note:*** *All the timeslots assigned to the data channel are always defined as data timeslots; this, however, does not preclude their use as voice channel carriers.*
START_TS	Selects the first timeslot assigned to the data channel	The allowed range is 1 to 31. Default: 1	When selecting a starting timeslot, you must consider the number of timeslots that need to be allocated to support the selected data rate
TS_TYPE	Selects the first timeslot assigned to the data channel	NC – Not connected . DATA – Timeslots connected and handled as if carrying data (transparently transfer through the main link). Default: USER	All the timeslots assigned to the data channel are always defined as data timeslots

Use – Ethernet Port

1. To define the parameters of the Ethernet port, type:

   DEF CH 2<Enter>

   The first row of the Ethernet port parameters data form is displayed. A typical row is shown below.

   This row is similar to that displayed for serial data channels, except that the CLOCK MODE field is always DCE, CTS is always N/A and CLOCK_POLARITY is always NORMAL.

```
MULTIPLIER    SPEED        FIFO_SIZE    CLOCK MODE    CTS
CLOCK_POLARITY
64            64 KBPS      AUTO         DCE           N/A
NORMAL
```

2. Change the desired parameters and then press <Enter> to display the Ethernet port configuration parameters row.

   A typical Ethernet port configuration parameters row is shown below.

```
AUTO_NEGOTIATION    ETHERNET MODE    BRIDGING    ETH_SPEED
FLOW_CONTROL
ENABLE              N/A              TRANS       N/A
ENABLE
```

3. Change the desired parameters and then press <Enter> to display the timeslot assignment parameters row. A typical form is shown below.

```
   MAP_MODE       START_TS       TS_TYPE
   SEQ            1              DATA
```

4. When done, press <Enter>.

Refer to *Table D-4* for a description of the parameters common to both the Ethernet port and the serial data channels, and to *Table D-5* for a description of the specific Ethernet port parameters.

Table D-5. Ethernet Port Configuration Parameters

Parameter	Function	Values	Configuration Guidelines
AUTO_ NEGOTIATION	Controls the use of auto-negotiation for the Ethernet port. Auto-negotiation is used to automatically select the mode providing the highest possible traffic handling capability	ENABLE – Auto-negotiation is enabled. DISABLE – Auto-negotiation is disabled. Default: ENABLE	Use auto-negotiation whenever the equipment connected to the same LAN supports this capanility

Parameter	Function	Values	Configuration Guidelines
ETHERNET MODE	Selects the Ethernet LAN traffic transfer mode when auto-negotiation is disabled. This parameter is not relevant when auto-negotiation is enabled (set to N/A and cannot be changed)	HALF – Half duplex operation. FULL – Full duplex operation. Default: HALF	Select in accordance with the capabilities of the equipment connected to the same LAN with the FCD-E1LC.
BRIDGING	Selects the Ethernet traffic processing mode	FILTER – The internal bridge of FCD-E1LC is enabled, and filters the traffic transferred to the remote end. TRANS – The internal bridge of FCD-E1LC is disabled, and the Ethernet traffic is transparently transferred (LAN extender function). Default: TRANS	
ETH_SPEED	Selects the LAN rate mode when auto-negotiation is disabled. This parameter is not relevant when auto-negotiation is enabled (set to N/A and cannot be changed)	10Mbps – operation at 10 Mbps. 100Mbps – operation at 100 Mbps. Default: 100Mbps	Select in accordance with the capabilities of the equipment connected to the same LAN with the FCD-E1LC.
FLOW_CONTROL	Controls the use of flow control for the Ethernet port	DISABLED – Flow control is disabled. ENABLED – Flow control is enabled. This selection is possible only when auto-negotiation is enabled. Default: DISABLED	The method used for flow control depends on the operating mode: • Back pressure for the half-duplex mode • Sending of *Pause* frames when operating in the full-duplex mode

DEF DNLOAD

Purpose

Define the inband management communication parameters. Refer to *Table D-6* for the parameter description, allowable ranges and configuration guidelines.

Syntax

DEF DNLOAD {[ML] [SL]}

Use

1. To define the main link inband management communication parameters, type:

   DEF DNLOAD ML<Enter>

   To define the sublink management communication parameters, type:

   DEF DNLOAD SL<Enter>

   The first row of the data form is displayed. A typical row is shown below:

```
DNLOAD MODE
TS0/F
```

2. Select the desired mode, and then press <Enter>.

   If the **FRAME RL** mode is selected, the following row appears:

```
TS_NUM     SPEED
1           64
```

3. Select the desired timeslot. The management data rate is always 64 kbps.
4. When done, press <Enter>.

   The following row appears:

```
SA_BIT_4   SA_BIT_5   SA_BIT_6   SA_BIT_6   SA_BIT_8
MGMT       ONE        ZERO       ZERO       ZERO
```

   Select the data to be carried by each of the S_{a4} to S_{a8} bits:

   - **ONE** or **ZERO** if the selected download mode is **FRAME RL**
   - **ONE** or **ZERO** or **MGMT** if the selected download mode is **TS0/F.** In this case, at least one of the bits must be set to MGMT.

5. When done, press <Enter> to end.

Table D-6. Download Configuration Parameters

Parameter	Function	Values	Configuration Guidelines
DNLOAD MODE	Selects the inband transmission mode for the selected link.	NONE – Inband SNMP and Telnet traffic is ignored and FCD-E1LC does not generate such traffic. TS0/F – Inband SNMP and Telnet traffic is received and transmitted in timeslot 0. FRAME_RL – Inband SNMP and Telnet traffic is received and transmitted in a dedicated, user-selected timeslot, using the Frame Relay protocol. Default: NONE	After changing the download mode from FRAME_RL to TS0/F and vice versa, you must reset the FCD-E1LC to make the changes in management effective (use the RESET command).
TS NUM	Selects the dedicated timeslot used for the selected link.	Any number in the range of 1 through 31, consistent with the available timeslots and the link framing mode. Default: 1	This parameter is displayed only when the Frame Relay mode is selected
SPEED	Selects the data rate used to transfer inband management traffic for the selected link.	Always 64 kbps	This parameter is displayed only when the Frame Relay mode is selected.
SA4	Controls the handling of the national bit Sa4.	**MGMT** The S_{a4} bit is used to carry inband management traffic. **ZERO** The S_{a4} bit is set to "0" before it is transferred to the S_{a4} bit of the external E1 interface. **ONE** Same as above, except the Sa4 bit is set to "1". Default: **ONE**	When the INB_MNG parameter is TS0/F, at least one of the bits must be set to MGMT.
SA5	Controls the handling of the national bit Sa5 by the corresponding port	Same options as for **SA4**	
SA6	Controls the handling of the national bit Sa6 by the corresponding port	Same options as for **SA4**	
SA7	Controls the handling of the national bit Sa7 by the corresponding port	Same options as for **SA4**	
SA8	Controls the handling of the national bit Sa8 by the corresponding port	Same options as for SA4	

DEF MANAGER LIST

Purpose

Define or modify the network management stations to which the SNMP agent of this FCD-E1LC system will send traps. Up to five managers can be defined.

Syntax

DEF MANAGER LIST

Use

1. To define a management station, type:

   `DEF MANAGER LIST<Enter>`

   You will see the current list of managers, in the following format:

```
                  OLD MANAGERS LIST PARAMETERS
MANAGER 1 IP ADDRESS IS  :     192.168.238.001
MANAGER 1 SUBNET MASK IS :     255.255.255.240
MANAGER 2 IP ADDRESS IS  :     192.168.200.253
MANAGER 2 SUBNET MASK IS :     255.255.255.000
MANAGER 3 IP ADDRESS IS  :     192.168.238.203
MANAGER 3 SUBNET MASK IS :     255.255.255.240
MANAGER 4 IP ADDRESS IS  :     192.114.029.209
MANAGER 4 SUBNET MASK IS :     255.255.255.000
MANAGER 5 IP ADDRESS IS  :     192.168.238.196
MANAGER 5 SUBNET MASK IS :     255.255.255.240
```

   After the current table, you will see the first row of the managers list data form, which is used to define the IP address of the first management station.

2. Type in the IP address of the desired management station. Use the dotted-quad format (four groups of digits in the range of 0 through 255, separated by periods).

3. After filling in the required address, press <Enter> to display the next row, and then type in the subnet mask in the dotted-quad format. The mask consists of four groups of digits in the range of 0 to 255, separated by periods. The mask specified by these digits must consist of consecutive “1”s, followed by consecutive “0”s.

   A typical data form, as seen after both rows used to define the first management station have been filled in, is shown below:

```
MANAGER 1 IP ADDRESS        172.165.68.221
MANAGER 1 SUBNET MASK       255.255.255.000
```

4. Repeat Step 3 to define the additional management stations (2 through 5).

5. After pressing <Enter> for the subnet mask of the fifth manager, you will see the full updated list, and the command ends.

DEF ML

Purpose

Define the main link parameters.

Syntax

DEF ML

Use

1. To define the main link parameters, type:

   DEF ML<Enter>

   You will see the main link parameters data form. A typical data form is shown below:

```
FRAME        CRC-4        SYNC        RX_GAIN       IDLE_TS_CODE
RAI
G732N        NO           CCITT       SHORT         3F
DISABLE
```

2. Select the desired parameters in accordance with *Table D-7*, and then press <Enter>.

Table D-7. Main Link Configuration Parameters

Designation	Function	Values	Configuration Guidelines
FRAME	Selects the framing mode for the main link	G732N – G.732N frame structure (2 frames per multiframe) in accordance with ITU-T Rec. G.732. Timeslot 16 can be used for user payload, for a total of 31 payload timeslots. G732S – G.732S frame structure (16 frames per multiframe) in accordance with ITU-T Rec. G.732. Leaves 30 timeslots for user payload. UNFRM – Unframed G.703 signal, carrying payload of a data channel. The appropriate data channel is automatically selected: channel 1 for an FCD-E1LC with one serial data channel, and channel 2 for an FCD-E1LC with two serial data channels. Default: G732N	Select the framing mode specified for use in your network. For transmission of unframed data, select UNFRM for the main link. For a single-channel FCD-E1LC, the data rate of channel 1 is automatically set to 2048 kbps. If FCD-E1LC has two data channels, the data rate of channel 2 is automatically set to 2048 kbps.

Designation	Function	Values	Configuration Guidelines
CRC-4	Enables the generation and evaluation of check bits (in accordance with the CRC-4 polynomial specified by ITU-T Rec. G.704)	NO – CRC-4 option disabled. YES – CRC-4 option enabled. Default: NO	Select YES, except when the FCD-E1LC main or sublink is connected to transmission equipment that does not support this option.
SYNC	Used to change the frame alignment algorithms, to reduce the time required for the link to return to normal operation after loss of sync	CCITT – Complies with ITU-T Rec. G.732. 62411 – Complies with AT&T TR-62411 (after 10 sec.). FAST – After 1 second. Default: CCITT	Select CCITT, unless your application has special requirements.
RX GAIN	Determines the maximum attenuation of the receive signal that can be compensated for by the main link receive path, to obtain the BER performance required by the standards	LONG – Maximum attenuation of 36 dB. SHORT – Maximum attenuation of 10 dB. Default: SHORT	The lower attenuation available with the SHORT value may actually improve the performance when operating over relatively short line sections, especially when operating over multi-pair cables. In such cables, significant interference is generated by the signals carried by other pairs and therefore, a weak desired signal may be masked by the interference.
IDLE_TS_ CODE	Selects the code transmitted to fill idle (unused) timeslots in the main link frame	You can also select any desired code in the range of 00 to FF (presented as hexadecimal numbers). Default: 3F	Select the value specified for use on the corresponding link in your network. Select the same value at the other end. FCD-E1LC allows you to select any two-digit hexadecimal value.
RAI	Controls the transfer of the RAI (remote alarm indication) from the main link to the optional sublink	ENABLE – The reception of RAI by the main link interface causes the FCD-E1LC sub interface to send RAI to the equipment connected to the sublink. DISABLE – The RAI indication sent by the sublink is not affected by RAI reception via the main link. Default: DISABLE	Select in accordance with the requirements of your specific application

DEF NAME

Purpose

Define the node name (up to eight alphanumeric characters).

Syntax

DEF NAME

Use

1. To define the FCD-E1LC node name, type:

   DEF NAME<Enter>

   FCD-E1LC displays the current name in the following format:

   ```
   OLD NAME = 'old name'
   ```

   where **'old name'** is the name FCD-E1LC is currently assigned.

   The current name is followed by the name entry form:

   ```
   ENTER NODE NAME (MAX 8 CHARACTERS) =
   ```

2. Type the desired name, and then press <Enter>. The new name is displayed in the following format:

   ```
   CURRENT NAME = 'name'
   ```

   where 'name' is the FCD-E1LC current node name.

DEF NODE

Purpose

Define the FCD-E1LC node number, or address. The allowed range is 0 to 255.

Syntax

DEF NODE

Use

1. To define the FCD-E1LC node number, type:

   DEF NODE<Enter>

   FCD-E1LC displays the node entry form:

   ```
   NODE (0 to 255) =
   ```

2. Type the desired number in the range of 0 to 255, and then press <Enter>.

DEF PROMPT

Purpose

Select the supervisory port prompt.

Syntax

DEF PROMPT

Use

1. To select the supervisory port prompt, type:

   DEF PROMPT <Enter>

   The prompt selection form is displayed. A typical form is shown below:

```
PROMPT_TYPE
PRODUCT_NAME
```

2. To change the current selection, press <F> or <B>, then press <Enter> to end.

The available selections are as follows:

PRODUCT_NAME	The prompt displays the equipment type, FCD, followed by >.
GIVEN_NAME	The prompt displays the logical name assigned by means of the DEF NAME command, followed by >.

DEF PWD

Purpose

Define a new user password for FCD-E1LC.

Syntax

DEF PWD

Use

1. To define a new user password, type:

   DEF PWD<Enter>

   The current password entry screen appears:

```
OLD PASSWORD = 'old password'
```

   where 'old password' is the current password. The current password is followed by the password entry form:

```
NEW PASSWORD [4 to 8 CHARS] =
```

2. Type the required password (4 to 8 characters). Carefully check that the specified password has been indeed typed in, and then press <Enter>.

   The new password is displayed in the following format:

```
CURRENT PASSWORD = 'password'
```

Note *Before entering a new password, make sure that the PSW section of the FCD-E1LC internal switch SW2 is not set to ON, because in such case the default password (1234) is enforced.*

DEF ROUTE

Purpose

Define network management stations for which all the management traffic will be statically routed via the FCD-E1LC supervisory port, CONTROL DCE.

You can define static routes for up to 5 stations. A route is defined by specifying the IP address of the corresponding station.

You do not need to manually include stations with static routes in the managers list (see the DEF MANAGER LIST command): traps will be sent to the defined stations via the supervisory port even if the station does not appear in the managers list.

Syntax

DEF ROUTE

Use

1. To define a route, type:

   DEF ROUTE<Enter>

   You will see the current list of routes, in the following format:

```
ROUTE IP ADDRESS 1 IS: = 192.168.238.001
ROUTE IP ADDRESS 2 IS: = 192.168.200.253
ROUTE IP ADDRESS 3 IS: = 192.168.238.203
ROUTE IP ADDRESS 4 IS: = 192.114.029.209
ROUTE IP ADDRESS 5 IS: = 255.255.255.000
```

   After the current table, you will see the first row of the routes data form, which is used to define the IP address of the first management station.

2. Type in the IP address of the desired management station. Use the dotted-quad format (four groups of digits in the range of 0 through 255, separated by periods).

   After filling in the required address, press <Enter> to display the next row.

   Repeat the procedure to define the additional route (2 through 5). After pressing <Enter> for the fifth route, you will see the full updated list, and the command ends.

DEF SL

Purpose

Define the sublink parameters, and select the timeslots transferred to the main link.

This command is accepted only by FCD-E1LC units with sublink.

Syntax

DEF SL

Use

1. To define the sublink parameters, type:

   DEF SL<Enter>

   You will see the first row of the sublink parameters data form. A typical display is shown below:

```
FRAME        CRC-4       SYNC       RX_GAIN      IDLE_TS_CODE
RAI
G732N        NO          CCITT      SHORT        3F
DISABLE
```

2. Select the parameters in accordance with *Table D-8*, and then press <Enter> to display the second row of the sublink parameters data form.

   You will see the second row of the sublink parameters data form. A typical display is shown below:

```
CGA          OOS_SIG     OOS_CODE
NONE          N/A          00
```

3. Change the desired parameters and then press <Enter>:
   - If the **FRAME** parameter is **UNFRM**, the command is ended
   - If the **FRAME** parameter is **G732N** or **G732S**, you will see the timeslot mapping parameters row. A typical form is shown below.

```
MAP_MODE  START_TS  TS_TYPE  NUM_OF_TS
USER      N/A       N/A      N/A
```

4. Select the **MAP_MODE** and then press <Enter>.

Note *Before continuing, refer to the Sublink Timeslot Mapping Considerations section below for mapping guidelines.*

5. If in Step 4 the **MAP_MODE** has been set to **SEQ:**
   - Press the spacebar to move to the **START_TS** field, and then press <F> or <B> to select the desired starting timeslot.
   - Press the spacebar to move to the **TS_TYPE** field, and then press <F> or <B> to select the desired timeslot type.
   - Press the spacebar to move to the **NUM_OF_TS** field, and then press <F> or <B> to select the required number of timeslots. Note that if you select **00**, no sub timeslot is connected to the main link.
   - Press <Enter>. The command is ended and the FCD-E1LC will display the time and date, followed by the FCD-E1LC prompt.

6. If in Step 4 the **MAP_MODE** has been set to **USER**, the **START_TS**, **TS_TYPE** and **NUM_OF_TS** fields are automatically set to **N/A**. In this case, press <Enter> to continue.

   You will see the first row of the data channel timeslot assignment map. A typical display is shown below:

```
TS    :    1     2     3     4     5     6     7     8
TYPE  :    NO    NO    NO    NO    NO    NO    NO    NO
```

   - Use the spacebar to move between timeslots. For each timeslot, select between **NC**, **DATA** and **VOICE** by pressing <F> or <B>.
   - After completing the first row, press <Enter> to continue to the next row. Repeat the procedure until all the timeslots (up to 31) are configured.

7. Pressing <Enter> after the last timeslot ends the command.

Table D-8. Sublink Configuration Parameters

Designation	Function	Values	Configuration Guidelines
FRAME	Selects the framing mode for the sublink	See *Table D-7*	Select the framing mode specified for the equipment connected to the sublink.
CRC-4	See *Table D-7*		
SYNC	See *Table D-7*		
RX GAIN	See *Table D-7*		
IDLE_TS_ CODE	See *Table D-7*		
RAI	Controls the transfer of the RAI (remote alarm indication) from the sublink to the main link	ENABLE – The reception of RAI by the sublink interface causes the FCD-E1LC main link interface to send RAI to the equipment connected to the main link. DISABLE – The RAI indication sent by the main link is not affected by RAI reception via the sublink. Default: DISABLE	Select in accordance with the requirements of your specific application

Designation	Function	Values	Configuration Guidelines
CGA	Selects the method used to signal the carrier group alarm (CGA) state (link out-of-service) to the other equipment connected to the remote end of the sublink.	NONE – When the sublink is in the out-of-service state, the corresponding main link timeslots carry the OOS code selected by the user. TRANS – Same as for NONE, but the signaling bits are not forced to the OOS state. FULL – The state of the timeslots and the state of the signaling bits is not changed. This mode is Default: NONE	The selection depends on your particular application: • NONE is suitable for voice applications. • TRANS applications with common channel signaling (proprietary signaling) and for channelized data applications • FULL is a fully transparent mode, and is often used when the sublink carries channelized or unchannelized data
OOS_SIG	When NONE is selected for the CGA parameter, this parameter determines the state of the signaling bits during out-of-service periods	FORCED BUSY – The signaling bits are forced to the busy state during out-of-service periods. FORCED IDLE – The signaling bits are forced to the idle state during out-of-service periods. BUSY IDLE – The signaling bits are forced to the busy state for 2.5 seconds, then switch to the idle state until the out-of-service condition disappears. IDLE BUSY – The signaling bits are forced to the idle state for 2.5 seconds, then switch to the busy state until the out-of-service condition disappears. Default: FORCED IDLE	Select in accordance with the method specified for use in your network.
OOS_CODE	When NONE or TRANS has been selected for CGA, selects the code transmitted during out-of-service periods	The available selections are 00 to FF (hexa). Default: 00	Select in accordance with the code specified for use in your network.

Sublink Timeslot Mapping Considerations

Each sub timeslot selected by the user is connected to the timeslot with the same number of the main link.

The handling of the timeslot is configured by means of its type:

- **VOICE** – the timeslot is handled as a voice timeslot, that is, in addition to transferring the timeslot to the main link, the associated signaling information (carried in timeslot 16) is also copied to the corresponding bits in timeslot 16 of the main link.
- **DATA** – the timeslot is handled as a data timeslot, that is, when the FRAME parameter is G732S, the associated signaling information (carried in timeslot 16) is ignored.

Note

- *The VOICE type can be selected only when the sub **FRAME** parameter is **G732S**.*
- *When the **FRAME** parameter is **G732S**, leave timeslot 16 as **NC**.*
- *If you already selected an inband management timeslot (using the DEF DNLOAD SL command), the selected timeslot type appears as **DEDIC** and you cannot change this selection.*

You must connect a number of sub timeslots equal to that required by the equipment connected to the sublink. Any unconnected sublink timeslot is filled with the selected sublink idle timeslot code.

Remember that some of the main link timeslots must be assigned to other purposes, namely:

- The number of timeslots to be assigned on the main link to the data channel(s)
- Signaling information (timeslot 16 when using G732S framing)
- Timeslot dedicated to inband management, when using the FRAME_RL mode. This timeslot is selected using the DEF DNLOAD SL command (on the timeslot map, this timeslot appears as **DEDIC** and you cannot change this selection).

DEF SP

Purpose

Define the supervisory (CONTROL DCE) port parameters. Refer to *Table D-9* for the parameter description, allowable ranges and configuration guidelines.

Syntax

DEF SP

Use

1. To define the supervisory port parameters, type:

   DEF SP<Enter>

   The first row of the supervisory port parameters data form is displayed. A typical form is shown below. The form presents the current parameter values as defaults.

```
SPEED     STOP_BITS     PARITY     INTERFACE     CTS     DCD_DEL
DSR
AUTO      8             NO         DCE           =RTS    0 MS
ON
```

2. Change the parameter values by bringing the cursor to the beginning of the field to be changed using the spacebar, and then press <F> or <B> to scroll among the available selections. When the desired selection is displayed, press the spacebar to move to the next field.
3. When done, press <Enter> to display the second row of the supervisory port parameters data form. A typical display is shown below.

```
POP_ALM   PWD   LOG_OFF   CALL_OUT_TRIGER   ACTIVATE_CALL_OUT
AUXILIARY_DEVICE
NO        NO    NO        NONE              ANY CASE
TERMINAL
```

4. After the desired parameter values are selected, press <Enter> to end, and then press <Enter> to reconnect to the FCD-E1LC.

Table D-9. Supervisory Port Configuration Parameters

Parameter	Function	Values	Configuration Guidelines
SPEED	Selects supervisory port data rate.	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 – Supervisory port data rates in bps AUTO – Autobaud operation. Default: 19200 or AUTO	Select AUTO in order for the FCD-E1LC to automatically identify the incoming traffic data rate. In this case, to enable positive identification of the data rate, each connection to the supervisory port must start with three consecutive <Enter>. Do not use AUTO when the CONTROL DCE port is configured to use the SLIP or PPP protocol: in this case, you may lose the communication with the FCD-E1LC and you may have to reload the factory-default parameters.
STOP_BITS	Selects the number of stop bits in the CONTROL DCE port word format	1, 2 – Number of data bits Default: 1	The supervisory port word format should be the same as on the terminal.
PARITY	Controls the use of parity	ODD – Odd parity. EVEN – Even parity. NONE – Parity disabled. Default: NONE	The supervisory port word format should be the same as on the terminal.

Parameter	Function	Values	Configuration Guidelines
INTERFACE	Selects supervisory port interface	DCE – The CONTROL DCE port appears as a DCE for external equipment DTE – The CONTROL DCE port appears as a DTE, for connection via modem to the external equipment Default: DCE	Select DCE when FCD-E1LC is connected directly to the terminal. Select DTE when FCD-E1LC is connected to the terminal via a modem.
CTS	Controls the state of the CTS line in the CONTROL DCE port	ON – CTS line is always ON (active). =RTS – CTS line tracks the RTS line. Default: =RTS	
DCD_DEL	With the CONTROL DCE port defined as DTE, indicates the delay (in msec) between DCD=ON and sending of data	The available values are 0, 10, 50, 100, 200, and 300 msec. Default: 0	If you select a non-zero value when the port interface is programmed as DCE, you will receive an error message.
DSR	Controls the state of the DSR line	ON – DSR line is continuously on. It will switch to OFF for five seconds after the DTR line is switched OFF. =DTR – DSR line tracks the DTR line. Default: ON	If you select DSR=ON when INT is set to DTE, you will receive an error message.
POP_ALM	Controls the automatic sending of alarms to a terminal connected to the CONTROL DCE port	YES – The terminal automatically displays every 10 minutes the alarm status (or whenever an alarm which is not masked using the DEF ALM MASK command changes to ON). NO – No automatic display. Default: NO	
PWD	Controls password protection	YES – Password protection enabled. NO – Password protection disabled. Default: NO	

Parameter	Function	Values	Configuration Guidelines
`LOG_OFF`	Controls the idle disconnect time of the CONTROL DCE port	NO – Automatic session disconnection disabled. To end the session, use the BYE command. 3_MIN – Automatic disconnection after 3 minutes if no data is received by the CONTROL DCE port. 10_MIN – Automatic disconnection after 10 minutes if no data is received by the CONTROL DCE port. Default: NO	
`CALL_OUT_ TRIGGER`	Selects the type of alarms that will trigger the call-out function (reporting of alarms via a modem connected to the CONTROL DCE port)	NONE – The call-out function is disabled. ALL – FCD-E1LC will initiate a call after each new alarm. MAJOR – FCD-E1LC will initiate a call only when a new major alarm condition is detected. Default: NONE	
`ACTIVATE_ CALL_OUT`	If **`CALL_OUT_ TRIGGER`** is not set to **`NONE`**, defines when the call-out function is activated	ANY CASE – Call-out is activated in any case. LINK FAIL – Call-out is activated only when a link failure occurs or there is local or remote synchronization loss. Default: ANY CASE	
`AUXILIARY_ DEVICE`	Selects the management mode supported by the CONTROL DCE port.	TERMINAL – The CONTROL DCE port is connected using an ASCII supervision terminal. NMS-SLIP – The CONTROL DCE port connects to an SNMP management station and/or Telnet host using the SLIP protocol. NMS-PPP – The CONTROL DCE port connects to an SNMP management station and/or Telnet host using the PPP protocol. SLIP-AGENT – The CONTROL DCE port connects to another agent port using the SLIP protocol. See additional details in *Appendix B*. Default: TERMINAL	Select NMS-SLIP or NMS-PPP when the supervisory port must be able to use the SLIP, respectively NMS protocol, for example for SNMP or Telnet management. If the management connection to the FCD-E1LC CONTROL DCE port uses a chain topology (for example, when it is connected to the serial port of a Megaplex-2100), select SLIP-AGENT. Select TERMINAL if only the supervision terminal must be supported.

DEF SYS

Purpose

Define the system parameters. Refer to *Table D-10* for the parameter description, allowable ranges and configuration guidelines.

Syntax

DEF SYS

Use

To define the FCD-E1LC system parameters, type:

DEF SYS<Enter>

The system parameters data form is displayed. A typical form is shown below. The form presents the current parameter values as defaults.

```
CLK_MASTER     CLK_FBACK     DATE_FORMAT
ML             NONE          DD-MM-YYYY
```

After the desired parameter values are selected, press <Enter> to end.

Table D-10. System Configuration Parameters

Designation	Function	Values	Configuration Guidelines
CLK_MASTER	Selects the master system timing reference.	INT – Internal oscillator. ML – Locked to the recovered main link receive clock. SL – Locked to the recovered sublink receive clock. CH1 – Locked to the external clock supplied to the user data channel 1, provided the channel timing mode is DTE2. CH2 – Locked to the external clock supplied to the user data channel 2, provided the channel timing mode is DTE2. Default: ML	Select ML for connection to carrier lines. Select CH1 or CH2 for connection to a data network. Select INT at one end and ML at the other end for point-to-point lines.
CLK_FBACK	Selects the alternate (fallback) system timing reference, for use in case the master reference fails.	NONE – No fallback source is used. In this case, the internal oscillator is automatically selected when the master reference fails. ML – Locked to the recovered main link receive clock. SL – Locked to the recovered sublink receive clock.	Select a source different from that selected as master. Select NONE to disable switching to the fallback source. In this case, the default fallback clock source is the FCD-E1LC internal

Designation	Function	Values	Configuration Guidelines
		CH1 – Locked to the external clock supplied to the user data channel 1, provided the channel timing mode is DTE2. CH2 – Locked to the external clock supplied to the user data channel 2, provided the channel timing mode is DTE2. N/A – Appears when the internal oscillator has been selected as master reference, and therefore the fallback source is not relevant. Default: NONE	clock oscillator.
DATE_FORMAT	Selects the date display format	The available selections are DD/MM/YYYY, MM/DD/YYYY, and YYYY-MM-DD. Default: YYYY-MM-DD	

DEF TERM

Purpose

Define the control codes for use with one of the following types of terminals: TV920, VT52, VT100, Freedom 100/110 or Freedom 220, or reset the codes to 0. If you are using a different type of terminal, use the F command to define the desired codes. The codes used by the above-mentioned terminals are listed in *Table D-11*.

Table D-11. Supervision Terminal Control Codes

Function	Terminal Type				
	TV920	VT52	VT100	Freedom 100/110	Freedom 220
Clear Screen	1B2A0000	N/A	1B5B324A	1B2A0000	1B5B324A
Cursor Home	1E000000	1B480000	1B5B4800	1E000000	1B5B4800
Cursor Right	0C000000	1B424000	1B5B3143	0C000000	1B5B0143

Syntax

DEF TERM {‘terminal type’}

Use

1. To reset the terminal control codes to 0, type:

   DEF TERM<Enter>

2. To select the control codes for one of the above-mentioned types, type:

DEF TERM 'terminal type'<Enter>

where 'terminal type' stands for TV920, VT52, VT100, Freedom100, or Freedom220.

3. Press <Enter> again to end.

DSP AGENT

Purpose

Display the FCD-E1LC agent parameters.

Syntax

DSP AGENT

Use

To display the agent parameters, type:

DSP AGENT<Enter>

You will see the SNMP parameters data form. A typical form is shown below:

```
AGENT PARAMETERS
- - - - - - - - -
IP ADDRESS IS  : = 114.29.17.2
```

Refer to the *DEF AGENT* section for an explanation of the information displayed by this command.

DSP ALM

Purpose

Display the contents of the alarm buffer. This buffer can contain up to 100 alarms.

Syntax

DSP ALM /CA

Use

- To display the complete contents of the buffer, type:

  DSP ALM<Enter>

- To display the complete buffer contents and then clear all the alarms, type:

  DSP ALM /CA<Enter>

The contents of the alarm buffer are displayed as a table with four columns. The columns include the alarm code, alarm description, the link on which the alarm condition has been detected, alarm status, date and time of occurrence.

A header precedes each block of alarms received from an FCD-E1LC. The header lists the node number and the assigned node name, and it serves as an easily identified separator between the alarms transmitted by different FCD-E1LC units.

The alarm messages that can be displayed by the terminal are explained in *Chapter 4*.

DSP BERT ML

Purpose

Display the results of an on-going bit error ratio measurement on the data channel. When monitoring the BERT results, you may also start and stop error injection, and restart the error count by clearing the accumulated error results.

Note *Monitoring is not possible when using Telnet.*

The error injection rate is defined by means of the DEF BERT ML command.

Syntax

DSP BERT ML

Use

- To display the current results of the BER test on the data channel, type:

  DSP BERT ML<Enter>

- To display the current results of the BER test and then reset the error count, type:

  DSP BERT ML /C<Enter>

- To monitor the results of the BERT test, type:

  DSP BERT ML /R<Enter>

  In this case, you will see the commands you can use while monitoring the BER test results, and then the results themselves.

```
PRESS I FOR ERRORS INJECT
PRESS S FOR STOP ERRORS INJECT
PRESS C TO CLEAR ERROR BITS
```

Note *When using the single-error mode, pressing **I** injects a single error. To inject an additional error, first press **S** before pressing **I**.*

To stop the monitoring and obtain again the command prompt, press <CTRL+C> (BREAK). When using Telnet, it is not possible to monitor the results. Therefore,

use the following command to display the results and start the injection of errors:

DSP BERT ML /I<Enter>

and the command

DSP BERT ML /S<Enter>

to display the results and then stop the injection of errors.

The BER test results displayed on the screen are correct for the instant the display command has been issued (or since the last time the counters have been cleared, whichever occurred last). When the /R option is used, the results are periodically updated. The results are presented in the following format:

```
BERT OF CHANNEL - 1
ERROR_BITS  RUN_TIME(SEC)  ERRORS(SEC)  SYNC_LOSS(SEC)
ERROR_INJECT
0           3              0            0               OFF
```

The display fields are as follows:

ERROR_BITS	Total number of bit errors detected.
RUN_TIME(SEC)	Total time the test is running.
ERRORS(SEC)	Total number of seconds in which errors have been detected.
SYNC LOSS(SEC)	Total number of seconds in which loss of frame alignment occurred.
ERROR INJECT(SEC)	Indicates whether errors are injected (ON) or not (OFF).

Note *All the counters have a range of 0 through 65535. When the maximum value is reached, the counter freezes, therefore in general a value of 65535 indicates the counter has overflown.*

DSP HDR TST

Purpose

Display the results of the last hardware test (made during power-on self-test and during regular operation).

Syntax

DSP HDR TST

Use

To display the hardware test report, type:

DSP HDR TST<Enter>

The display has one field that shows NO HARDWARE FAILURE if everything checks well, or lists the detected problem: EPROM FAILURE, I/O EXP FAILURE, COUNTER FAILURE, ILLEGL SYS CNFG or SFIFO FAIL.

DSP MANAGER LIST

Purpose

Display the network management stations to which the SNMP agent of this FCD-E1LC system sends traps. The information that is provided for each network management station includes its IP address and the corresponding subnet mask.

Syntax

DSP MANAGER LIST

Use

- To display the current list of network management stations, type:

  DSP MANAGER LIST<Enter>

  You will see the list of network management stations that receive traps generated by this FCD-E1LC system. A typical display is shown below:

```
                    MANAGERS LIST PARAMETERS
---------------------------------------------------------------
MANAGER 1 IP ADDRESS IS      : 192.114.029.209
MANAGER 1 SUBNET MASK IS     : 255.255.255.240
MANAGER 2 IP ADDRESS IS      : 192.168.238.196
MANAGER 2 SUBNET MASK IS     : 255.255.255.000
MANAGER 3 IP ADDRESS IS      : 192.168.238.244
MANAGER 3 SUBNET MASK IS     : 255.255.255.240
MANAGER 4 IP ADDRESS IS      : 192.114.027.036
MANAGER 4 SUBNET MASK IS     : 255.255.255.000
MANAGER 5 IP ADDRESS IS      : 192.168.238.061
MANAGER 5 SUBNET MASK IS     : 255.255.255.240
```

DSP PM ML

Purpose

Display the contents of the main link performance monitoring registers specified by AT&T Pub. 54016. For an explanation of the performance monitoring registers, refer to the *Performance Diagnostic Data* section in *Chapter 4*.

Syntax

DSP PM ML [/C] [/CA]

Use

1. To display the main link performance monitoring registers, type:

   DSP PM ML<Enter>

2. To display the performance monitoring registers, and then clear only the event register, type:

   DSP PM ML /C<Enter>

3. To display the performance monitoring registers, clear all the performance monitoring registers of the main link, and restart the count intervals, type

   DSP PM ML /CA<Enter>

The performance monitoring registers are listed in the following order (the numbers in brackets indicate the range of values for each register).

```
                              PM OF - MAIN LINK
CRC ERROR EVENTS               =     [0] ..... [65535]
CRC AVG ERROR EVNTS            =     [0] ..... [65535]
CURRENT ES                     =     [0] ..... [900]
CURRENT UAS                    =     [0] ..... [900]
CURRENT SES                    =     [0] ..... [900]
CURRENT BES                    =     [0] ..... [900]
CURRENT LES                          [0] ..... [900]
CURRENT SEFS                         [0] ..... [900]
CURRENT LOFC                   =     [0] ..... [255]
CURRENT CSS                    =     [0] ..... [255]
CURRENT DM
CURRENT TIMER                  =     [0] ..... [900]
INTERVAL 01
ES=nnn UAS=nnn BES=nnn LES=nnn SEFS=nnn SES=nnn LOFC=nnn CSS=nnn DM=nnn
INTERVAL 02
ES=nnn UAS=nnn BES=nnn LES=nnn SEFS=nnn SES=nnn LOFC=nnn CSS=nnn DM=nnn
.
.
.
24 HOUR ES                     =     [0] ..... [65535]
24 HOUR UAS                    =     [0] ..... [65535]
24 HOUR SES                    =     [0] ..... [65535]
24 HOUR BES                    =     [0] ..... [65535]
24 HOUR LES                          [0] ..... [65535]
24 HOUR SEFS                         [0] ..... [65535]
24 HOUR LOFC                   =     [0] ..... [255]
24 HOUR CSS                    =     [0] ..... [255]
24 DEGRADE MIN                 =     [0] ..... [1440]
LAST 24 DEGRADE MIN            =     [0] ..... [1440]
24 INTERVAL                    =     [0] ..... [96]
```

where mm is 0 to 96, and nnn is 0 to 900.

DSP PM SL

Display the contents of the sublink performance monitoring registers specified by AT&T Pub. 54016. For an explanation of the performance monitoring registers, refer to the *Performance Diagnostic Data* section in *Chapter 4*.

Syntax

DSP PM SL [/C] [/CA]

Use

The sublink configuration parameters are similar to those of the main link. Refer to the DSP PM ML command for detailed information.

DSP REM AGENT

Purpose

Display information on the remote SNMP agents that are known to the FCD-E1LC management traffic router, provided SNMP management is enabled.

Syntax

DSP REM AGENT

Use

1. To display the remote agent information, type:

   DSP REM AGENT<Enter>

   A typical table listing the remote agents is shown below:

```
IP ADDRESS               MUX NAME         DISTANCE
- - - - - - - - - - - - - - - - - - - - - - - - -
192.114.050.002          New-York         13
192.114.150.122          Chicago          9
```

Note *If no remote agents are known, you will see a CANNOT FIND REMOTE AGENTS.*

The fields displayed for each agent are as follows:

IP ADDRESS	The IP address of the remote agent.
MUX NAME	The logical name of the remote agent.
DISTANCE	Metric that indicates the logical distance (through the management network) to the remote agent, and is used, among other factors, in the selection of the optimal route to be used by the management traffic.

2. To display the remote agent information including management stations that are connected to FCD-E1LC, type:

   DSP REM AGENT /A<Enter>

   You will see a table listing the remote agents. A typical table is shown below:

IP ADDRESS	MUX NAME	DISTANCE
192.114.029.209	** NMS **	15
192.168.238.196	** NMS **	12
192.168.238.244	** NMS **	9
192.114.027.036	** NMS **	7
192.168.238.061	** NMS **	2
192.168.238.001	** NMS **	3
192.168.200.253	** NMS **	3
192.168.238.203	fcd245	5

DSP ST CH

Purpose

Display status information on serial data channels.

Syntax

DSP ST CH CC

Use

- To display the data channel status information, type:

  DSP ST CH CC<Enter>

  where CC is the desired channel number, 1 or 2.

  A typical channel status display is shown below:

```
STATUS OF CHANNEL - X
LOOPS TYPE          =  LOCAL      REMOTE
                       NO         NO
PORT STATE          =  CONNECTED
RTS/CONTROL STATE   =  OFF
INTERFACE           =  V.35
```

The fields included in the status display are listed below:

LOOPS Displays the current state of the loopbacks activated on the data channel.

The LOCAL field indicates the local loopback state:

- NO – local loopback is deactivated.
- YES – local loopback is activated.

The REMOTE field indicates the remote loopback state:

- NO – remote loopback is deactivated.
- YES – remote loopback is activated.

PORT STATE Displays whether the data channel is connected to the main link:

- CONNECTED – the channel is connected.
- NOT CONNECTED – the channel is not connected.

RTS STATE Displays the RTS line state in the serial data channel connector:

- OFF – the RTS line is not active.
- ON – the RTS line is active.

INTERFACE Displays the interface type:

- V.35 – V.35 interface
- X.21 – X.21 interface
- RS-232 – V.24/RS-232 interface
- RS-530 – RS-530 interface or V.36/RS-449 via adapter cable
- IR-ETH/QN – Ethernet 10/100BaseT bridge with VLAN support.

DSP ST ML

Purpose

Display main link status information.

Syntax

DSP ST ML [/C]

Use

1. To display the main link status information, type:

   DSP ST ML<Enter>

2. To display the main link status information, and then clear its error event registers, type:

   DSP ST ML /C<Enter>

   A typical main link status display is shown below.

```
STATUS OF  -  MAIN LINK
TYPE              = E1
FUNCTION          = COPPER UNBALANCE
ALARMS            L.SYNC LOSS    R.SYNC LOSS
                  ===========    ===========
                  OFF            OFF
LOOPS                DIGITAL         ANALOG
                  LOCAL  REMOTE   LOCAL  REMOTE
                  =====  ======   =====  ======
                  NO     NO       NO     NO
                  BERT   RX_INBAND   TX_INBAND
                  =====  =========   =========
                  NO     NO          NO
DOWNLOAD MODE     = NONE
OOS CNTR          = 1
BPV LAST MINUTE   = 0
BPV WORST MINUTE  = 0
```

The fields included in the status information displays are listed below:

TYPE Indicates the main link interface, E1.

INTERFACE Indicates the currently selected main link interface type: COPPER BALANCE or COPPER UNBALANCE, balanced or unbalanced

ALARMS Indicates the state of the port alarms:

- L.SYNC LOSS – state of local frame synchronization.
- R.SYNC LOSS – state of remote frame synchronization.

LOOPS Indicates the state of loops that can be activated on the main link:

- DIGITAL LOCAL – This field displays YES to indicate that the local digital loopback has been activated.
- DIGITAL REMOTE – This field displays YES to indicate that the remote digital loopback has been activated.
- ANALOG LOCAL – This field displays YES to indicate that the local analog loopback has been activated.
- ANALOG REMOTE – This field displays YES to indicate that the remote analog loopback has been activated.
- BERT – This field displays YES to indicate that the BER test has been activated.
- RX_INBAND This field displays YES when a loopback has been connected as a result of the reception of the inband remote loopback activation sequence.
- TX_INBAND This field displays YES to indicate that the user requested the sending of the inband remote loopback activation sequence.

DOWNLOAD MODE	Displays the inband management mode selected for the main link: TS0/F or FRAME RL
OOS CNTR	Displays the number of local loss of frame alignment events detected since the last time the counters were cleared.
BPV LAST MINUTE	Displays the number of BPV events detected in the last minute.
BPV WORST MINUTE	Displays the number of BPV events detected during the worst minute since the last time the counters were cleared.

DSP ST SL

Display sublink status information.

Syntax

DSP ST SL [/C]

Use

The sublink configuration parameters are similar to those of the main link, except that there are no BERT, RX_INBAND and TX_INBAND fields. Refer to the DSP ST ML command for detailed information.

DSP ST SYS

Purpose

Display system status information.

Syntax

DSP ST SYS

Use

- To view the system status, type:

  DSP ST SYS<Enter>

  A typical system status display is shown below.

```
NODE = 'node number'
NAME = 'FCD-E1LC name'
NODAL CLOCK = INT
SOFTWARE VER = 01.00
HARDWARE VER = 00.02
FCD TYPE = E1/2
POWER SUPPLY = AC
```

The fields included in the system status information displays are listed below:

NODE	The node number (0 through 255) assigned to the FCD-E1LC.
NAME	The system name assigned to the FCD-E1LC.

NODAL CLOCK	Indicates the nodal clock source: INT, CH1, CH2 or ML.
SOFTWARE VER	The software version of the FCD-E1LC.
HARDWARE VER	The hardware version of the FCD-E1LC.
FCD TYPE	Indicates the type and the number (1 or 2) of data channels of this FCD-E1LC.

DSP TS

Purpose

Display information on the use and type of main link timeslots.

Syntax

DSP TS

Use

- To display the timeslot information, type:

  DSP TS<Enter>

  A typical display is shown:

```
TS :      01    02   03    04    05   06   07    08    09    10

TYPE :    DATA  NC   DATA  DATA  DATA NC   DEDIC DATA  DATA  NC

DEST :    CH1   NA   CH2   NA    NA   NA   ML    CH1   NA    NA


TS :      11    12   13    14    15   16   17    18    19    20

TYPE :    DATA  NC   DATA  DATA  DATA DATA NC    DATA  DATA  NC

DEST :    CH1   NA   CH1   NA    NA   NA   NA    CH2   NA    NA


TS :      21    22   23    24    25   26   27    28    29    30    31

TYPE :    DATA  NC   DATA  DATA  DATA NC   DATA  DATA  DATA  NC    NC

DEST :    CH1   NA   NA    CH2   NA   NA   NA    CH1   NA    NA    NA
```

The fields included in the timeslot displays are listed below:

TS Indicates the main link timeslot number, 1 through 31.

TYPE Indicates the timeslot utilization:

- NA – timeslot not connected (FCD-E1LC inserts the idle code in such timeslots).
- DATA – data channel.

- **DEDIC** – timeslot dedicated to management traffic.

DEST Indicates the port (or channel) using that timeslot.

- **ML** – main link.
- **S1** – sublink.
- **CH1** – data channel 1
- **CH2** – data channel 2.

EXIT

Purpose

End the current communication session.

Syntax

EXIT

Use

- To end the current communication session, type:

  EXIT<Enter>

F

Purpose

Define the codes used to be sent to the supervision terminal to perform the following terminal control functions:

- Clear screen.
- Move cursor to screen home position.
- Move cursor to the right by one position.

If you have a TV920, VT52, VT100, Freedom 100 or Freedom 220 terminal, you can use the DEF TERM command to set the control codes for that terminal.

Syntax

F

Use

1. To display the current codes, type:

   F<Enter>

   The terminal function entry screen is displayed. The screen includes three separate rows, displayed one after the other.

   A typical screen, showing all the three rows, is shown below:

```
CLEAR SCREEN = hhhhhhhh
CURSOR HOME  = hhhhhhhh
CURSOR RIGHT = hhhhhhhh
```

where h indicates hexadecimal digits.

2. To change a code, enter the appropriate hexadecimal digit under the first digit of the code, the cursor advances to the next digit.
3. Repeat the procedure until all the necessary digits are changed, and then press <Enter> to end.

HELP

Purpose

Display an index of the supervision terminal commands, and the options available for each command.

Syntax

HELP

Use

Type:

HELP<Enter>

You will see the first HELP page. Press the spacebar to see the next page.

INIT DB

Purpose

Load the default parameter values (see *Table D-12*) instead of user's configuration.

Syntax

INIT DB

Use

To load the default parameters, type:

INIT DB<Enter>

After reloading the default parameters, FCD-E1LC displays the following message:

```
FCD Supervisory Port On Line. Type 'H' for help
```

and then the time and date fields followed by the FCD-E1LC prompt.

Table D-12. FCD-E1LC Default Configuration Used with Supervision Terminal

Type	Parameter Designation	Default Value
General	PASSWORD	1234
	NODE (node number)	0
	CLEAR SCREEN	00 00 00 00
	CURSOR HOME	00 00 00 00
	CURSOR right	00 00 00 00
System	CLK_MASTER	ML
	CLK_FBACK	NONE
	DATE_FORMAT	YYYY-MM-DD
	LEARNING_MODE	DISABLED
Main Link	FRAME	G732N
	CRC-4	NO
	SYNC	CCITT
	IDLE_TS_CODE	00
	RX_GAIN	SHORT
Download Parameters	MODE	NONE
	TS NUM	N/A
	SPEED	N/A
Data/Ethernet Channels	SPEED	NC
	MAP_MODE	USER
	START_TS	N/A
	TS TYPE	N/A
	FIFO_SIZE	AUTO
	CLOCK_MODE	DCE
	CTS	ON
	ETHERNET MODE	HALF
	BRIDGING	TRANS
	CLOCK_POLARITY	NORMAL
	TIMESLOT MAP	
	DEST	NONE
	TYPE	NC
BERT Parameters	BERT_PATTERN	2E23-1
	ERROR_INJECTION_RATE	NO_ERR
	RX_INBAND	DISABLE
	INBAND_LOOP_PATTERN	RDL LOOP

Type	Parameter Designation	Default Value
SP (Supervisory Port)	SPEED	AUTO
	STOP BIT	1
	PARITY	NO
	INTERFACE	DCE
	CTS	=RTS
	DCD_DEL	0_MSEC
	DSR	ON
	PWD	NO
	POP_ALM	NO
	LOG_OFF	NO
	CALL_OUT_TRIGGER	NONE
	ACTIVATE_CALL_OUT	ANY CASE
	AUXILIARY_DEVICE	TERMINAL

LOOP

Purpose

Activate the specified user-initiated test or loopback. If you want to activate an additional loopback or test while another is already activated, first refer to *Chapter 4* for lists of allowed combinations.

If you try to activate a loopback or test not allowed at this stage, you will see ERROR 051 - ILLEGAL PORT LOOP COMBINATION).

Note *The FCD-E1LC rear-panel E1/T1 LOOPBACK switch can also be used to activate the following loopbacks:*

- *Main link local analog loopback*
- *Main link remote analog loopback*
- *Sublink local analog loopback*
- *Sublink remote analog loopback.*

The functions of this switch are described in Chapter 2. To activate a loopback, the corresponding switch section must be set to ON.

Syntax

LOOP {'loopback'}

Use

1. To activate all the main link loopbacks and tests, type:

   LOOP ML<Enter> or LP ML<Enter>

   To activate a specific main link loopback or test, type:

   LOOP LOC ANA ML<Enter> or **LP LOC ANA ML<Enter>**
   LOOP REM ANA ML<Enter> or **LP REM ANA ML<Enter>**
   LOOP LOC DIG ML<Enter> or **LP LOC DIG ML<Enter>**

LOOP REM DIG ML<Enter> or **LP REM DIG ML<Enter>**
LOOP BERT ML<Enter> or **LP BERT ML<Enter>**
LOOP INBAND ML<Enter> or **LP INBAND ML<Enter>**

2. To activate all the sublink loopbacks and tests, type:

   LOOP SL<Enter> or LP SL<Enter>

   To activate a specific sublink loopback or test, type:

   LOOP LOC ANA SL<Enter> or **LP LOC ANA SL<Enter>**
   LOOP REM ANA SL<Enter> or **LP REM ANA SL<Enter>**
   LOOP LOC DIG SL<Enter> or **LP LOC DIG SL<Enter>**
   LOOP REM DIG SL<Enter> or **LP REM DIG SL<Enter>**

3. To activate a data channel loopback, type:

   LOOP LOC CH 1<Enter> or **LP LOC CH 1<Enter>**
   LOOP LOC CH 2<Enter> or **LP LOC CH 2<Enter>**
   LOOP REM CH 1<Enter> or **LP REM CH 1<Enter>**
   LOOP REM CH 2<Enter> or **LP REM CH 2<Enter>**

Notes

- *Inband loopback and BER testing are available on channel 1 only.*
- *The activation of an inband loopback is made by repeatedly transmitting the activation sequence, therefore the loopback can be considered as activated only after approximately 2 seconds.*

If the requested loopback is already active, you will receive ERROR 053: CURRENT LOOP ALREADY BEING PERFORMED. If the requested loopback is not supported by the FCD-E1LC version, you will receive ERROR 055: LOOP NOT SUPPORTED ON CURRENT FCD TYPE.

If you are trying to activate a loopback on a data channel of an FCD-E1LC with Ethernet interface, you will see ERROR 056: ILLEGAL COMMAND FOR CURRENT PORT MODE. Nevertheless, the BERT test (LOOP BERT) is allowed.

RESET

Purpose

Reset the FCD-E1LC system.

Syntax & Use

- To reset the FCD-E1LC, type:

  RESET<Enter>

  You are requested to confirm the operation.

TIME

Purpose

Set the time for the FCD-E1LC internal clock.

Syntax

TIME

Use

1. To set the FCD-E1LC internal clock time, type:

   TIME<Enter>

   FCD-E1LC sends the time entry form:

```
HOUR     = 12
MINUTE   = 25
SECOND   = 16
```

2. Bring the cursor to the first field to be changed by pressing <Enter> and use <F> or <B> to change the digits.
3. Set the time about one minute beyond the current time, and then press <Enter> at the correct instant.

FCD-E1LC will display the time and date fields (note that time has changed), followed by the FCD-E1LC prompt.

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Customer Response Form

RAD Data Communications would like your help in improving its product documentation. Please complete and return this form by mail or by fax or send us an e-mail with your comments.

Thank you for your assistance!

Manual Name: FCD-E1LC version 1.0

Publication Number: 389-200-11/08

Please grade the manual according to the following factors:

	Excellent	*Good*	*Fair*	*Poor*	*Very Poor*
Installation instructions	❒	❒	❒	❒	❒
Operating instructions	❒	❒	❒	❒	❒
Manual organization	❒	❒	❒	❒	❒
Illustrations	❒	❒	❒	❒	❒
The manual as a whole	❒	❒	❒	❒	❒

What did you like about the manual?

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Error Report

Type of error(s) or problem(s):

- ❒ Incompatibility with product
- ❒ Difficulty in understanding text
- ❒ Regulatory information (Safety, Compliance, Warnings, etc.)
- ❒ Difficulty in finding needed information
- ❒ Missing information
- ❒ Illogical flow of information
- ❒ Style (spelling, grammar, references, etc.)
- ❒ Appearance
- ❒ Other ______________________________

Please list the exact page numbers with the error(s), detail the errors you found (information missing, unclear or inadequately explained, etc.) and attach the page to your fax, if necessary.

____

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Please add any comments or suggestions you may have.

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You are:

- ❒ Distributor
- ❒ End user
- ❒ VAR
- ❒ Other

Who is your distributor? ______________________________

Your name and company: ______________________________

Job title: ______________________________

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